MEMBER AUDIT BUREAU OF CIRCULATIONS

THE WELDING ENGINEER

Vol. 22, No. 5 MAY, 1937

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The Welding Engineer

VOLUME XXII MAY, 1937 NUMBER 5

Welding and Casting—

Not Welding vs. Casting . . .

From a paper read before the Chicago Section, American Welding Society, on March 19, 1937.

By H. J. SHIFFLI
Product Engineer, American Steel Foundries

WELDING represents one of the greatest single developments in the whole field of engineering technology. It has become an established method of fabrication and is finding its proper place in competitive industry. The progress made in the art during the past few years has resulted in the fabrication of many units by this method.

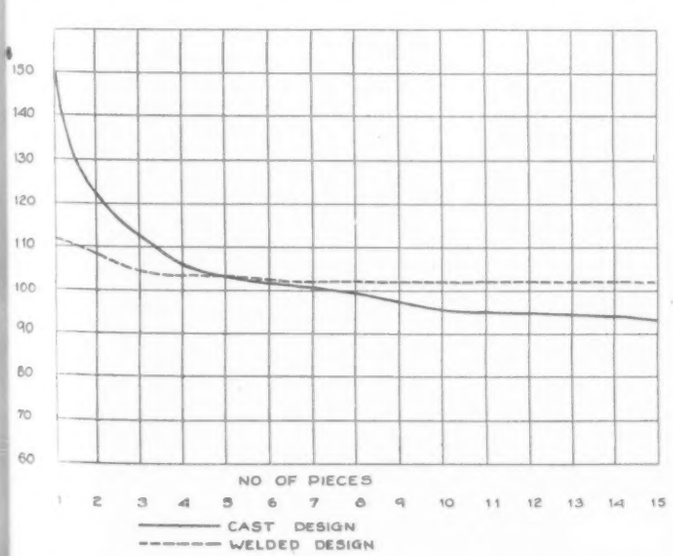
As indicated by recent articles in the various trade journals, its advantages are numerous: notably simplicity, weight reduction, quicker delivery, flexibility in repair work, favorable cost factor, etc. Quite naturally, enthusiasts for welding have freely predicted the early disappearance of castings from the marts of trade. However, we must bear in mind that many of the favorable features associated with the welded fabrication apply equally well to the steel casting.

Lack of precedent hindered the designer in his early attempts to produce welded structures. Usually such structures were not much more than copies of their cast or riveted predecessors. Inadvertently, the cast-iron or cast-steel structure was merely replaced part for part with rolled steel and shapes. This resulted in nothing gainful except perhaps a slight saving in weight.

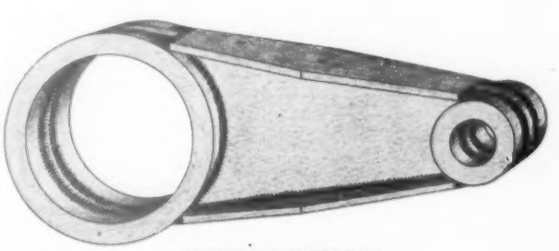
Economy Is Not Always Served by Eliminating All Castings

Wisely, far-sighted welding engineers soon discovered that it would be necessary to devote more thought to improved design. They recognized the fact that a new medium was at hand by which they might express their ideas. Here was an opportunity to break away from tradition. As might be expected, the welding engineer swung the pendulum too far toward the exclusion of steel castings. Many designers entirely ignored the foundry's existence. Today, the consensus of opinion is that the steel casting has a very definite place in the present and future scheme of welded fabrication.

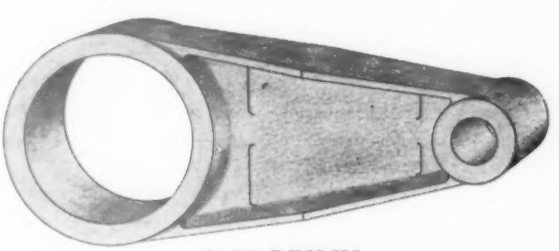
In a complex structure, a steel casting can often be substituted for intricate welded shapes. The cost of a finished construction produced entirely by welding, increases directly with the number of separate pieces involved and the number of inches of welding required. The



Cost Curves Based on Cast Design and Welded Design of Construction Shown at Right.



WELDED DESIGN



CAST DESIGN

(The part shown is about 7 ft. long, and the outside diameter of the large bearing is about 20 in.)

welding trade journals are replete with examples of combination cast-and-welded fabrications. This clearly indicates the present-day resourcefulness of the designer.

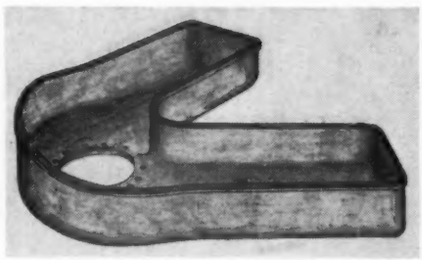
Welding Has Not Reduced the Use of Steel Castings

The early predictions that welding would cause a decrease in the use of steel castings have not materialized. As a matter of fact, we can expect to find a new impetus given to the use of the cast-steel product. A recent investigation shows that instead of being regarded as a menace, welding processes are considered a logical complement to the foundry art.

Laws of economics must eventually govern the selection of all industrial materials. A sound merchandising philosophy is gradually developing, based on the realization that every individual metal is a good material, if and when used where it belongs economically.

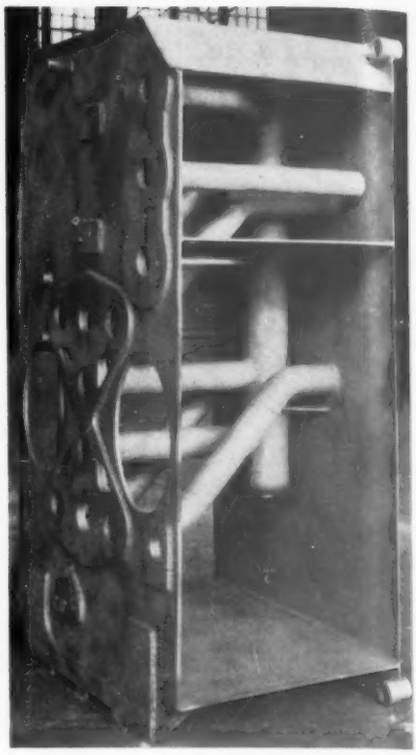
The engineer of today then, in order to reason logically whether he is to cast or weld, must be conversant with material and labor costs of both methods. At present many industrial plants have the facilities to use either method of manufacture. In many cases the final structure is a combination of both.

Such factors as quantity required, delivery, weight reduction, stress concentration, appearance, amount of direct labor involved, amount of machining required, etc., do not necessarily apply to one specific method of manufacture.



All-Welded Sump Tank Shown at Right, and Cast-Steel Discharge Header Shown Above.

(This tank, about 7 ft. in maximum dimension, was built with a tolerance of $\frac{1}{16}$ in. on all sides. The working pressure is 305 lb. per sq. in., and it was tested at 600 lb. per sq. in. The discharge header shown above is to be mounted under the top plate (shown as a side plate in the illustration at the right) of the tank. This header could have been made an all-welded structure, but a cost analysis based on the quantity required showed the casting to be more economical.)



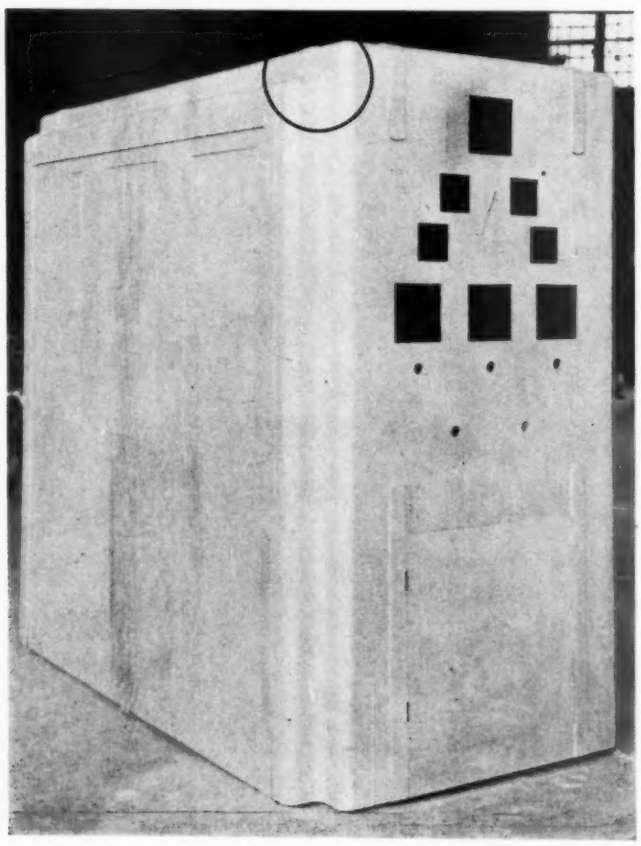
They may apply equally as well to the casting as to the welding under certain existing conditions.

Quantity Required Is Often the Determining Factor

For example, if one only is required of a certain machine part or piece of equipment, generally speaking, the welded fabrication is favored. If multiple units are required, in many cases the casting is preferred, especially where the design is complicated. Obviously, in quantity production the pattern cost is soon dissipated. For a comparison, see the accompanying cost curves. Though plant facilities and burdens vary in different organizations, the general characteristics of the curves as shown still hold good.

When delivery is a deciding factor and only one or a few pieces are required, usually the welding method is quicker, owing to the time taken in making the pattern. When many are required and the design does not lend itself to simplification, the casting has an excellent opportunity.

The resultant weight reduction of the welded fabrication over the cast-iron structure does not hold good for cast steel, in view of the fact that cast steel is equally as strong as the rolled steel used in welded construction.



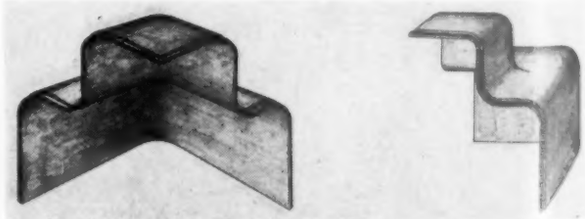
Cabinet of Welded Construction

(Height, about 7 ft. The intricate shape of the corner section (shown in circle) necessitated a steel casting, two views of which are shown below. This corner piece could have been shaped by pressing, but the quantity required did not warrant a costly die charge.)

Welding Has Caused Foundrymen to Become Design-Minded

Welding has not only helped to make foundrymen metal-conscious, but it has caused them to become design-minded. The quality of metal in the steel casting has improved. Furthermore, the design of steel castings now reflects a better placement of the metal.

Welded construction lends itself ideally to the solution of stress concentration. Here again improved design enables the steel casting to hold its own. Castings which are intended to become parts of a combination cast-and-welded



structure receive the proper heat-treatment before any welding is done. The final stress-relieving operation given to a completed structure containing both steel castings and rolled steel does not materially affect the grain structure in the welding zone.

Little can be said concerning the appearance or eye appeal of a casting as compared to a welded structure. Opinions may vary because esthetic ideals are merely a matter of taste.

Castings Are Often Economical for Intricate Parts

In considering the amount of direct labor involved, especially in the combination structure, we must take into account the quantity required and the intricacy of design. If a large number of individual pieces are required to make a structure and an excessive amount of welding and flame cutting are necessary, a casting should be considered for the more intricate part.

Where no special exactness is required, the smooth surfaces of rolled plates can frequently be used without machining. At present, many steel castings are produced with surfaces that are sufficiently smooth and true to meet the required specifications. In this case, neither type of construction has a marked advantage over the other since a close tolerance still demands that they both must be machined.

We often hear and see the words, "Casting vs. Welding." This statement is rather misleading, for they certainly are not opponents. A very definite relationship exists between welding and steel founding. Broadly speaking, these branches of industry are complementary rather than opposed to each other. An up-to-date steel foundry does use welding. Likewise, an up-to-date weldery does use steel castings where castings by virtue of their physical and economical characteristics are the proper thing. The combinations of steel castings, rolled steel and shapes are infinite.

It is to the credit of the welding and steel-casting industries that so much work has been done successfully. They both are interested in the final results of their joint product. The hearty cooperation given by these groups in the past should insure future progress.

Robert Hale Submits First Paper in Prize Competition

Robert S. Hale, 1008 Atlas Bank Building, Cincinnati, has the distinction of submitting the first paper in competition for the $200,000 awards of The James F. Lincoln Arc Welding Foundation, according to A. F. Davis, Foundation secretary, Cleveland, O. Mr. Hale is an architect and structural engineer and holds the position of construction engineer, Procurement Division, Public Buildings Branch, United States Treasury Department.

Although the actual contents of Mr. Hale's paper will not be known until the paper is delivered to the Jury of Awards on June 1, 1938, together with all other competing papers, the subject of the paper relates to the construction field, in which the use of arc welding has made marked progress in recent years.

A. W. S. Selects Hays as Managing Director

Warner S. Hays has been appointed managing director of the American Welding Society. Mr. Hays has an unusual background of experience in engineering, sales, publishing, membership development and association management.

Mr. Hays was graduated from Yale Sheffield Scientific School, where he specialized in electrical engineering. Following graduation, he went to work for

Warner S. Hays, Appointed Managing Director of American Welding Society.

the General Electric Co. at Schenectady and Pittsfield, spending several years in the Testing and Engineering Departments and acquiring practical experience in the operation of power stations. Subsequently he became purchasing agent and assistant general manager of the Interurban and Traction Lines of Rockford, Ill., and later of the Light, Power and Traction lines of DeKalb and Sycamore, Ill. Following his experience in the public-utility field, Mr. Hays became circulation and field manager of the McGraw Publishing Co., New York.

During the World War he was an officer in the construction division of the United States Army. Since the war, Mr. Hays has maintained his own consulting, engineering and association executive office in Philadelphia. He has served many individual firms, the Government, and industries on personal relations, reorganizations, association management, advertising and merchandising surveys, and has conducted campaigns for technical, engineering and trade associations. He is a past president of the American Trade Association Executives.

Regarding Mr. Hays' appointment, A. E. Gibson, president, made the following statement:

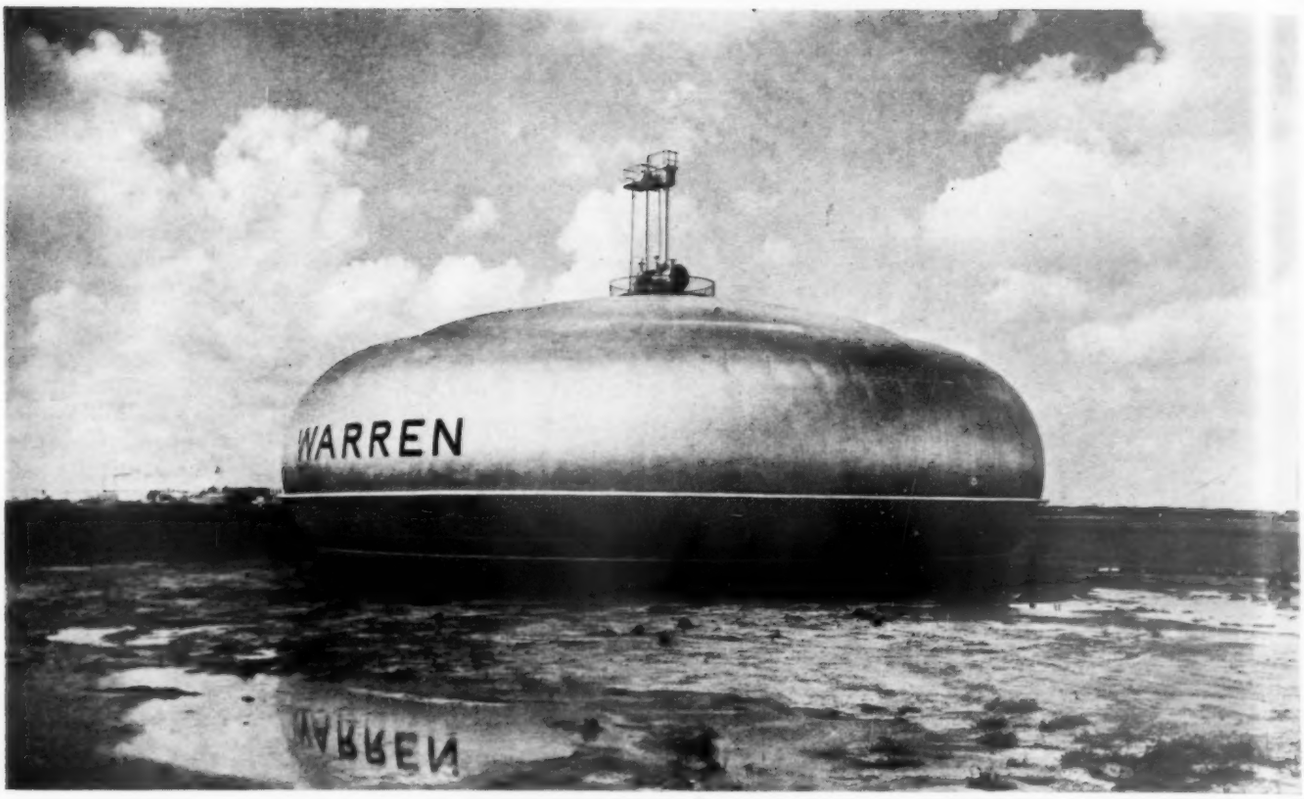
"The selection of Mr. Hays as manager of the American Welding Society is part of the program adopted by the Board of Directors at the annual meeting in Cleveland last October. Through this program it is expected that the Society will be better situated to serve its members and the welding industry. Mr. Hays' work is expected to greatly increase the membership in the Society. During the past six months six hundred new members have been appointed and several new local chapters established. Within the coming year it is anticipated that the total membership will be increased nearly 100% and the number of local chapters doubled. Mr. Hays will lighten the load carried by the officers and members of the Society, and will more effectively consummate the Society's objectives."

NEMA Welding Section to Assist A. W. S. Program

Recognizing the important functions of the American Welding Society as a technical spokesman for the welding industry, the NEMA Electric Welding Section, at its January, 1937, meeting, voted to furnish financial support for the expansion program which the A.W.S. recently proposed. A matter of immediate importance is the coordination of tests of men, machines and filler metal, so as to relieve some of the unnecessary burden which a great duplication of test requirements has brought about. It is also very desirable to increase the membership of the society, and especially to secure members from a larger number of industrial companies.

A. E. Gibson, after an enviable record as head of the Cleveland Section, accepted the presidency of the A.W.S. with the understanding that he wished to enlarge both its membership and its activities. The society is not equipped financially to carry out some of these desirable projects from current income, but the NEMA Welding Section has expressed its confidence in the future of the society and in Mr. Gibson's leadership, by this recent action. They will underwrite the new A.W.S. program to the extent of $10,000.

At the March meeting of the NEMA Welding Section, a coordinating committee was appointed to work with the management committee of the A.W.S. and to make this fund available as it is required for support of the new activities.



100,000-Barrel Hortonspheroid of Welded Construction, for Internal Working Pressure of 10 Lb. per Sq. In.
(This structure, 141 ft. 6 in. in diameter and 40 ft. high, was built for the Warren Petroleum Co. at Port Arthur, Tex.)

Application of Welding *to* Large Steel Tanks . . .

From a paper read before the Illinois Society of Engineers, Chicago, Jan. 28, 1937.

By H. C. BOARDMAN
Director of Research,
Chicago Bridge & Iron Co.

IN THE welding of large steel tanks, the effect of the welding heat on the plate material must be considered. These tanks are usually of ASTM-A10 or ASTM-A7 material.

Welding Heat Results in Shrinkage Stresses

During the heating period, the hot metal is largely prevented by the cooler adjacent plate material from expanding, except at right angles to the plate. The heating, therefore, causes a thickening of the plate, and the subsequent cooling results in shrinkage stresses, which are frequently nearly up to the yield point in the direction of the joint, and at right angles to the joint vary in magnitude depending upon the degree of restraint of the parts being joined.

The intensity of welding stresses may be reduced by giving the parts freedom of movement during welding; by welding in short steps or increments so that the shrinkage strains of the steps are not cumulative; and by a judicious use of peening. Eventually, there may come into general use special electrodes producing a weld metal having an appreciably lower modulus of elasticity than the plate material. Such electrodes have been developed in Germany, and it is claimed that the residual stresses after welding with them are negligible.

If the electrode is a bare rod, air gets into the arc and molten metal, and the weld, though strong, is brittle, and resists corrosion poorly.

If, however, the electrode is coated with suitable materials, of either vegetable or mineral base, which burn as the electrode melts, the arc is protected from the air by means of gases and the molten metal is protected by slag. The resultant weld metal is not only strong, but ductile, and resists corrosion better than the plate itself. Heavily coated electrodes which give these desirable results are commonly called shielded-arc electrodes, and it is largely to them, but partly to improved generators, that the marvelous increase in the welding of tanks since 1931 is due. Some shielded-arc electrodes are suitable for down flat welding in grooves only, others are best for fillet welding, and still others give good results in all welding positions.

Prior to 1931, much electric-arc welding was done with bare electrodes on field-erected tanks, but only on accessories, and nominally unstressed parts, such as cone roofs and flat bottoms. Now, however, there is no type of field-

erected tanks, or part thereof, which is not laying satisfactorily welded in spite of the adverse conditions frequently encountered in the field.

The field-welding operator is usually not as well supervised as his shop brother, and often the parts fit less perfectly than do pieces assembled in the shop. He necessarily leads a roving life, not conducive to the peace of mind and serenity of spirit needed for the best welding. He contends with wind, and rain, and heat, and cold, and dust, from all of which shop men are relatively free. And much of his most important work is done on vertical or horizontal seams on vertical sheets, which are harder to weld than seams on horizontal surfaces. He is also frequently tempted by a piece-work pay system to sacrifice quality for quantity. Yet, all things considered, he does a remarkably good job, as proved by the spendid service records of the many tanks which he has welded. Failures have been very few.

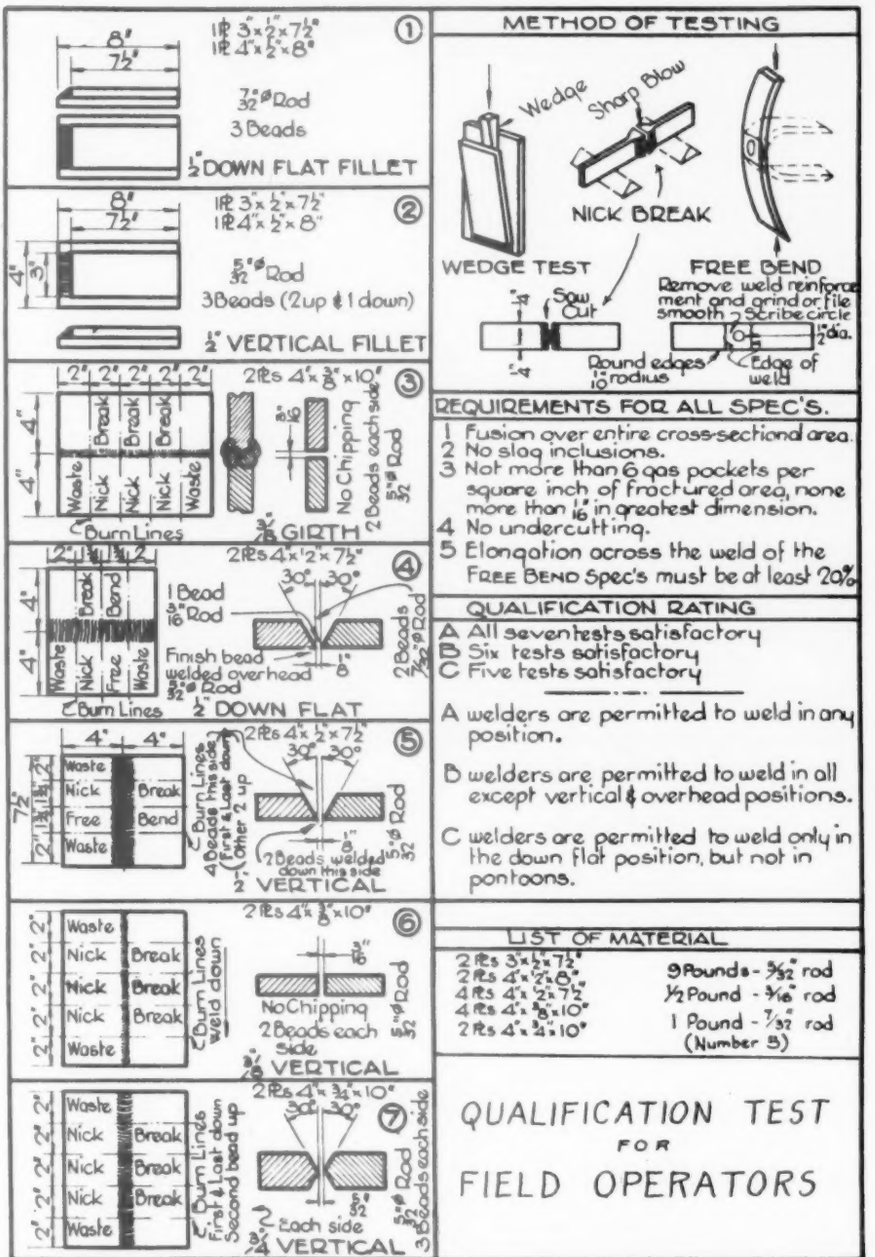
Qualification Tests Are a Part of Operator's Training

Qualification tests are an essential part of the training of a field-welding operator. A typical set of qualification tests, involving the welding and testing of seven different types of specimens, is shown in accompanying sketches. These tests are for the sole purpose of qualifying operators. Much more searching and comprehensive tests to qualify the materials, process and equipment necessarily must precede the operators' tests, but these need not be repeated unless some element in the process is changed.

Tests for qualifying operators must indicate the size of electrode to be used, the number of passes, and the direction of travel of the electrode for each pass. Different organizations have different welding procedures and types of joints suited to their particular electrodes and fabricating and erection equipment. There is as yet no fixed rule governing the conditions calling for a downward travel of the electrode on vertical joints. Generally, however, square-butted vertical joints, and 3/16- and ¼-in. vertical lap joints are welded with the electrode moving downward; and vertical double- and single-V or -U joints are welded with a downward travel of the electrode for the first and outermost passes, and with an upward travel for all other passes. The small, initial downward-pass layer forms a bridge across the gap between abutting edges, upon which subsequent thicker upward-pass layers may be built, and it causes relatively little contraction; the outer thin downward-pass layers give the weld a good external appearance, and, to some extent, refine the upward-pass layers on which they are deposited.

Butt-welded girth joints are almost always made with string beads so laid that the finished weld looks as if it were formed by a number of parallel wires or strands nested in the groove.

Accompanying sketches show joint details typical of flat-bottomed storage tanks with vertical butt-welded cylindrical shells and dome or cone roofs; also joint details typical of the same structure with shells butt welded where the plates are over ⅜-in. thick, and lap welded where they are ⅜-in. and less in thickness. Both the vertical and girth joints are shown to indicate fusion throughout the entire plate thickness.


METHOD OF TESTING
Wedge
Sharp Blow
NICK BREAK
WEDGE TEST
FREE BEND
Remove weld reinforcement and grind or file smooth
Saw Cut
Round edges 1/16" radius
Edge of weld
REQUIREMENTS FOR ALL SPEC'S.
1 Fusion over entire cross-sectional area.
2 No slag inclusions.
3 Not more than 6 gas pockets per square inch of fractured area, none more than 1/16" in greatest dimension.
4 No undercutting.
5 Elongation across the weld of the FREE BEND Spec's must be at least 20%
QUALIFICATION RATING
A All seven tests satisfactory
B Six tests satisfactory
C Five tests satisfactory
A welders are permitted to weld in any position.
B welders are permitted to weld in all except vertical & overhead positions.
C welders are permitted to weld only in the down flat position, but not in pontoons.
LIST OF MATERIAL
2 Pcs 3"x½"x7½"
2 Pcs 4"x½"x8"
4 Pcs 4"x½"x7½"
4 Pcs 4"x⅜"x10"
2 Pcs 4"x¾"x10"
9 Pounds - 5/32" rod
½ Pound - 3/16" rod
1 Pound - 7/32" rod (Number 5)
QUALIFICATION TEST FOR FIELD OPERATORS
1 ½ DOWN FLAT FILLET
3 Beads
½ VERTICAL FILLET
3 Beads (2 up & 1 down)
GIRTH
No Chipping
2 Beads each side
½ DOWN FLAT
1 Bead
Finish bead welded overhead
VERTICAL
Burn Lines
Waste
Nick
Break
Bend
Free

Specimen 1 is a lap joint welded in a down flat position. This joint is typical of lap-welded roofs and bottoms and of the fillet welds joining shells and flat bottoms.

Specimen 2 is a lap joint welded with the seam in a vertical position, and is typical of lap-welded vertical shell joints.

Specimen 3 is a square-butted girth joint with a gap between abutting edges. In an actual structure, this type of joint is commonly limited to plates ¼ in. and less in thickness, but good operators can weld plates ⅜ in. in thickness.

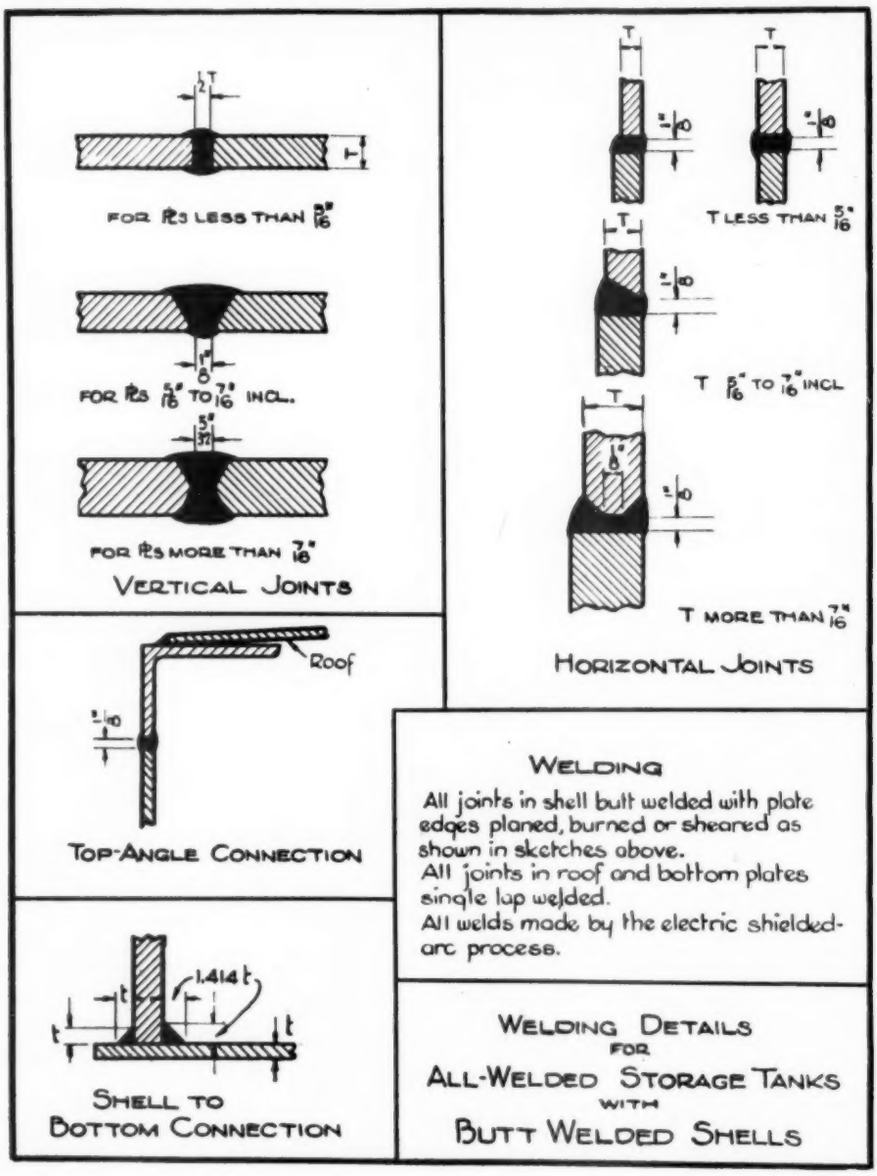
Specimen 4 is a single-60°-V butt joint welded with the plate in a horizontal position. The finishing bead on the apex side is welded overhead. This joint is typical of those in flat butt-welded bottoms, and in the tops and bottoms of spheres.

Specimen 5 is the same as 4, except that it is welded with the seam vertical, and is typical of vertical single-V joints in the shells of oil-storage tanks, standpipes, elevated tanks, spheres, etc.

Specimen 6 is the same as 3, except that it is welded with the seam vertical, and is typical of square-butted vertical joints. In practice, this type is commonly used only with thicknesses of ¼ in. and less, although good operators can readily weld plates ⅜ in. thick.

Specimen 7 is a double-60°-V joint welded with the seam vertical, and is typical of double-V vertical joints in the thicker courses of oil-storage tanks, standpipes, elevated tanks, etc.

80,000-Barrel Welded Gasoline Storage Tank Equipped With a Wiggins Pontoon Roof. Location, Lima, Ohio.


FOR T'S LESS THAN 5/16"
FOR T'S 5/16" TO 7/16" INCL.
FOR T'S MORE THAN 7/16"
VERTICAL JOINTS
T LESS THAN 5/16"
T 5/16" TO 7/16" INCL
T MORE THAN 7/16"
HORIZONTAL JOINTS
Roof
TOP-ANGLE CONNECTION
1.414 t
SHELL TO BOTTOM CONNECTION
WELDING
All joints in shell butt welded with plate edges planed, burned or sheared as shown in sketches above.
All joints in roof and bottom plates single lap welded.
All welds made by the electric shielded-arc process.
WELDING DETAILS FOR ALL-WELDED STORAGE TANKS WITH BUTT WELDED SHELLS

Unquestionably the vertical joints, which are highly stressed, should be fully welded, but logically the girth joints, which are subjected to very small loads, need be welded only sufficiently to provide for corrosion, to hold the adjacent edges in line, and to provide a small reserve to withstand uneven settlement of the foundations. Nevertheless, because it is difficult to set up inspection standards for anything less, most companies are now providing, and many purchasers now requiring, complete fusion in girth as well as vertical joints. The lone exception is the direct shell-to-bottom connection, where a fillet bead is made each side of the shell.

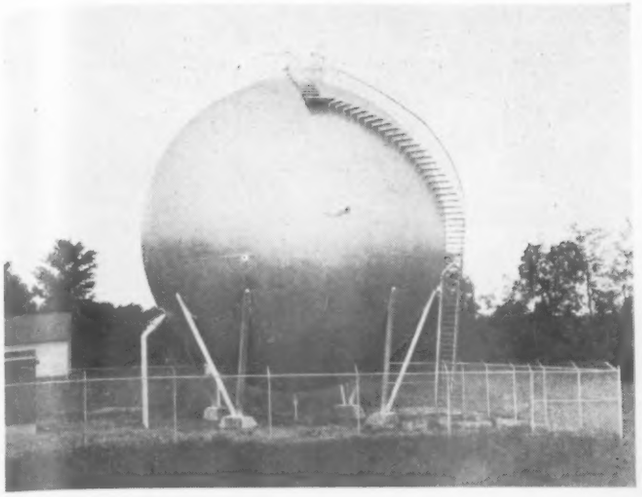
In lap-welded construction, on the other hand, vertical joints are commonly fully welded on both edges only if the stress requires it, and girth joints are usually continuously welded on one edge and tack welded on the other.

Allowable Joint Efficiencies Depend on Several Factors

Under the Tentative American Petroleum Institute Rules for Oil Storage Tanks, butt-welded joints are allowed an efficiency of 85%, fully welded lap joints an efficiency of 70%, and partially welded lap joints an efficiency of $50 + 1/5\ k\ \%$, where k is the percentage of full fillet intermittent welding on the partially welded edge. The minimum permissible value of k is 25%.

For welded oil storage tanks, the above joint efficiencies are applied to 21,000 lb. per sq. in. as a base for steels having a tensile strength of 55,000 lb. per sq. in. or more.

For such welded pressure tanks as spheres, spheroids, and cylindrical



(Above) **Hortonsphere for Storage of Gas at 100 Lb. Pressure.**
(This structure, 40 ft. in diameter, is located at Saratoga Springs, N. Y.)

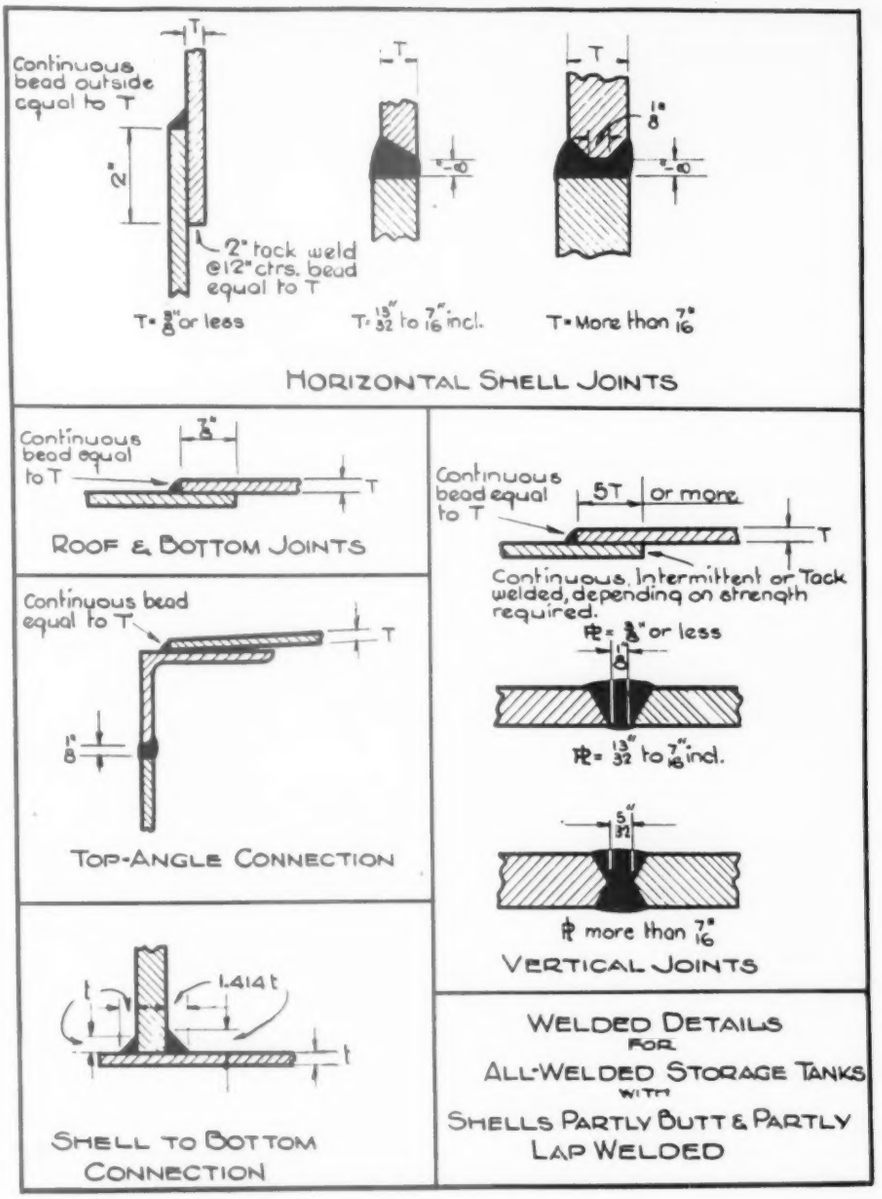
(Right) **500,000-Gallon Colonial-Design Elevated Tank.**
(Located at Decatur, Ga. Tank bottom is 68 ft. 2 in. above ground.)

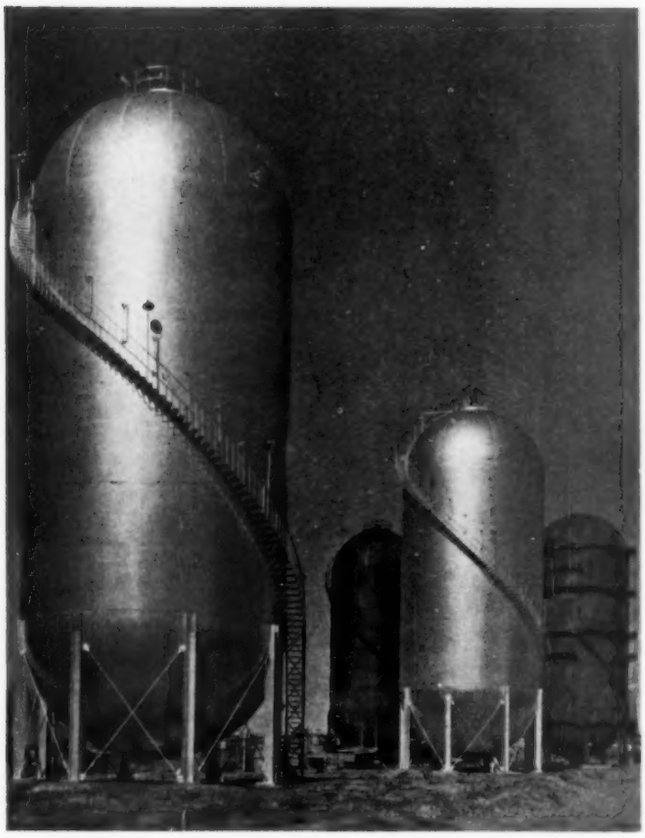
shells with hemispherical ends, the joint efficiencies are commonly applied to 13,750 lb. per sq. in. as a base for steels having a minimum tensile strength of 55,000 lb. per sq. in. Under the API-ASME Code governing the design of such vessels, the joint efficiency varies with the type of joint, the quality of material, and whether radiographing or furnace stress-relieving is employed. Under this Code, the joints of a butt-welded vessel made of ASTM-A10 steel that are neither radiographed nor stress-relieved would be permitted an efficiency of only 74%. If ASTM-A70 firebox steel were used, other factors remaining the same, the efficiency would be 80%. If, in addition to using ASTM-A70 firebox material, the joints were radiographed, an efficiency of 90% would be granted, and if the vessel were both radiographed and stress-relieved, using A-70 firebox steel, the design could be based on joints having an efficiency of 95%.

Pressure Vessels Are Usually Butt Welded

Pressure vessels are almost invariably completely butt welded. For spheres and spheroids, a single-60°-V groove is commonly used. The upper half of a sphere is usually welded from the outside, against backing-up bars tack-welded on the inside to one of the abutting edges; the lower half is welded mostly from the inside, but a small groove is chipped from the outside, along the apex of the V, into good weld metal deposited from the inside, and then filled by overhead welding.

The bottoms of spheroids are commonly laid directly on the sand or earth bed prepared for them, and butt welded together from the top side against back-


Continuous bead outside equal to T
2" tack weld @12" ctrs. bead equal to T
T = 3/8" or less
T = 13/32 to 7/16" incl.
T = More than 7/16"
HORIZONTAL SHELL JOINTS
Continuous bead equal to T
ROOF & BOTTOM JOINTS
Continuous bead equal to T
TOP-ANGLE CONNECTION
1.414 t
SHELL TO BOTTOM CONNECTION
Continuous bead equal to T
5T or more
Continuous, Intermittent or Tack welded, depending on strength required.
t = 3/8" or less
t = 13/32 to 7/16" incl.
t more than 7/16"
VERTICAL JOINTS
WELDED DETAILS FOR ALL-WELDED STORAGE TANKS WITH SHELLS PARTLY BUTT & PARTLY LAP WELDED



Vertical Pressure Tanks for Storage of Butane.

(These structures, located at Borger, Texas, are 34 ft. in diameter and 51 ft. 10 in. high and have a capacity of 12,000 barrels each.)

ing-up bars on the underside. The roof plates are similarly welded from the top side against backing-up strips. The side sheets may be welded from both sides—or from the outside only, against bars on the inside.

Welding is rapidly replacing riveting in the large-elevated-tank field. Few towers have been completely welded, but many tanks proper have been welded completely, or nearly so. The methods of assembly and welding are similar to those for spheres and spheroids. Welding has given impetus to the growing use of tubular columns.

It is well known that a welding arc struck on a cold plate often causes a crack, and that the discomfort of a welding operator when he is cold is likely to reduce the quality of his work. Therefore, for both metallurgical and humanitarian reasons, welding is usually forbidden during very cold weather. There is a wide difference of opinion as to what the limiting temperature should be. The Navy has set 20°F.; others think 0°F. is about right; and some would fix 32°F. as the limit. A small amount of preheating prior to welding is helpful.

Fit-Up Holes Are Neither Necessary Nor Desirable

It is no longer considered advisable or necessary to drill or punch holes in plates for assembly purposes. Devices have been developed by which plates are quickly and accurately assembled, and the gap between abutting edges adjusted to and held at the desired amount.

To avoid unsightly buckles and dangerous cracks, it is necessary that pieces be welded in proper sequence and with as little restraint as possible to normal shrinkage. For example:

Welding Sequence for Oil-Storage Tanks

The vertical joints in each shell ring of an oil-storage tank are fully welded before the ring is welded to the course above and below. The vertical joints of the lowest shell ring are completely welded, and the lower edge of the ring then welded to the outer bottom plates before the latter are welded to each other or to the interior bottom plates. The interior bottom plates are next welded into sections, then the sections welded together, and finally the outer bottom plates are welded to each other and to the interior plates. If the bottom were welded into a complete disk, and then the shell welded to it, cracks along the bottom edge of the shell would probably result, because the tendency of the shell to reduce in diameter as welding progressed would be resisted by the nearly rigid bottom.

The cost of radiographing field-erected vessels is at present practically prohibitive. Therefore, the quality of the welding must depend largely upon suitable materials and equipment; the character, training, and mental and physical comfort of the operators; good fabrication and assembly; and adequate supervision. Trepanning cylinders of weld metal out of the completed joints at unexpected times and places has a helpful psychological effect upon the operators.

The service records of welded tanks have proved them to be better than riveted tanks in that they cost no more—usually less—and they do not develop leaks in service. The day seems near when practically all large tanks will be welded, perhaps by automatic or semi-automatic processes. The possibilities of welding challenge the imagination. None can put a limit upon them. Manual direct-current electric-arc welding only has been discussed in this paper, but there are many other welding processes, any one of which may eventually displace it. Welding irresistably marches on, daily doing new things, and presenting fascinating problems for solution.

Building Officials to Hold Conference in Cleveland

The 22nd annual convention of the Building Officials' Conference of America will be held at the Hotel Hollenden in Cleveland, O., during the week beginning May 31. That week has been designated by Harold H. Burton, mayor of Cleveland, as "Builders' Week," and Thursday, June 3, will be observed as "Builders' Day" at the Great Lakes Exposition.

Many other organizations will cooperate in this meeting, which will mark the first move toward assembling in one conference the material manufacturer, the architect, the engineer, the contractor and the building official. The mezzanine floor and ballroom of the Hotel Hollenden have been set aside as an exhibit hall during the conference.

Boiler and Pressure-Vessel Inspectors to Hold Meeting

Major changes in the construction and design of boilers and pressure vessels, together with the development of new materials contemplated in the construction of such vessels, will receive consideration at the eleventh general meeting of the National Board of Boiler and Pressure Vessel Inspectors, to be held at the Hotel McAlpin, in New York, N. Y., on May 24 to 26. Morning and afternoon sessions will be held on each of the three days, and all sessions will be open to anyone interested.

The following subjects pertaining to welding will be discussed: Welding problems in connection with high-tensile-strength low-alloy steel; Welding of power-plant piping; Non-destructive inspection of welded pressure vessels; Welding of high-strength copper alloys; General problems in the repair by weld-

Fabricating One of the "Tree-Form" Columns.

All Aisles Have Clear Space From Floor to Roof.

ing of boilers, pressure vessels and pipelines; General problems of welding in the light of today's experience; Welding of alloys; Necessity of maintaining high standards for welded vessels. A special committee has prepared an exhibit showing both sound and defective welding, failures experienced in operation, and new construction and design of boilers and pressure vessels.

Saw-Tooth Frame Employs "Tree-Form" Columns

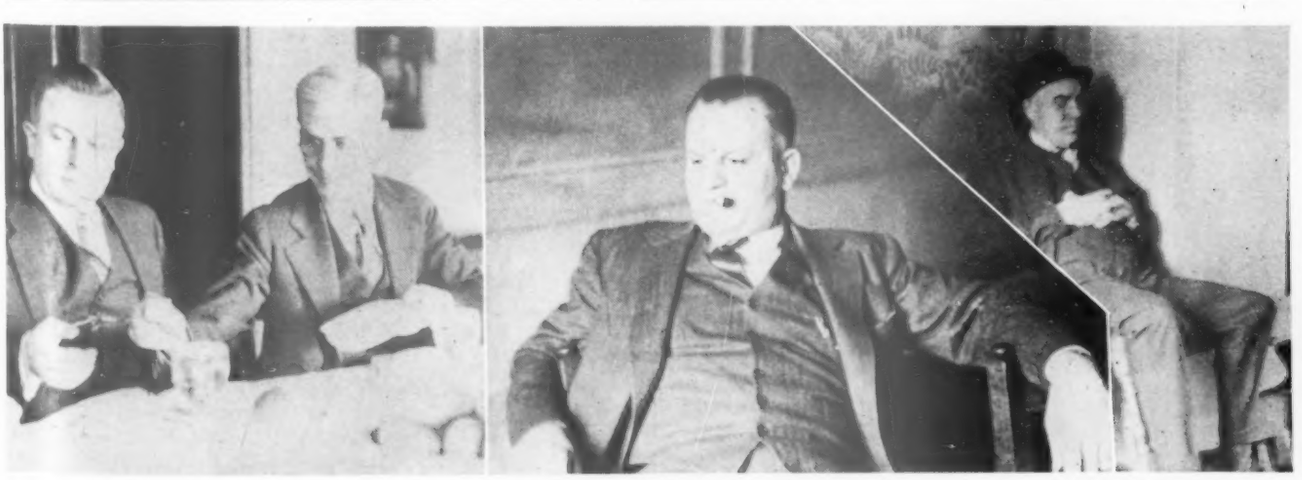
The first industrial plant to employ the new welded rigid-frame saw-tooth design recently developed by The Austin Co., of Cleveland, O., is nearing completion at Meriden, Conn., for the International Silver Co., the country's largest producers of silverware.

This new type of structure, with modern exterior distinguished by continuous horizontal runs of sash, will obtain 100% availability of space from floor to roof by the elimination of all cross-members and trusses. Clearances ranging from 14 ft. at the top of special "tree-form" columns to 27 ft. at the peak of each saw-tooth, is obtained by welded roof members which span ten 40-ft. production aisles. This will allow for maximum flexibility of operations throughout the plant, which will be devoted to the stamping and buffing of the company's well-known flatware lines.

The unusual design, which applies natural tree forms to eliminate all cross-members and trusses, facilitates daylighting through the saw-tooth monitors, which face to the north to insure maximum intensity and uniformity of light. Artificial light will be provided by fixtures of the most modern type.

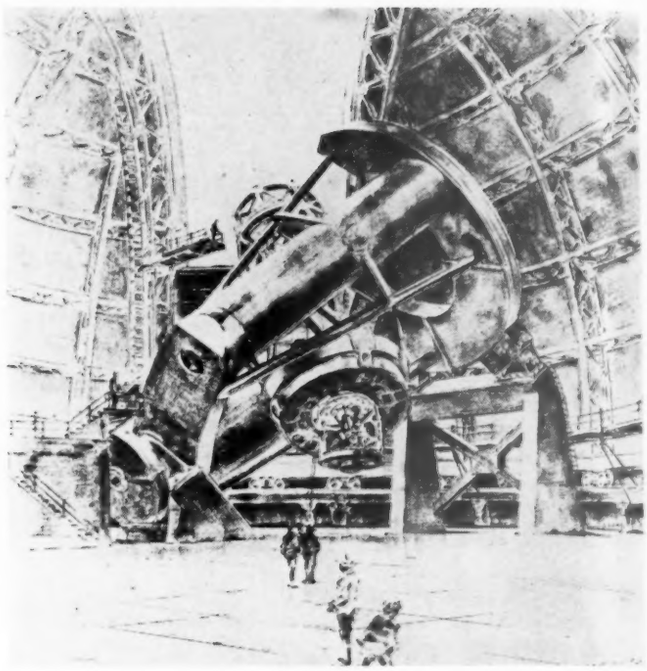
The roof deck has been constructed of insulated metal to reduce heating costs in the winter time and to maintain comfortable working temperatures inside throughout the summer. Inasmuch as drop hammers are to be installed throughout the stamping department, special acoustical treatment is being provided over an area of about 8,000 sq. ft., to absorb the noise of the hammers and thereby minimize the disturbance resulting from such operations.

The floor is being built up on a concrete sub-base 6 in. thick, in which creosoted timbers will be embedded. It will be surfaced with factory maple on a wood base, except in the locker and toilet sections, where monolithic concrete will be used.



THE CANDID CAMERA VISITS THE NEMA INDUSTRY CONVENTION.

Views of notables taken while the Welding Section of NEMA was in session at the Buffalo Athletic Club, the night of April 22, arranging standards for the industry. Left to right: Leslie Pfeil is being asked by Chairman Reddie to pass the spinach (a long, hard session is just ahead); "Duke" Howland still had his eyes open, but two minutes after the shot was taken he had lapsed into unconsciousness; "Mike" Holslag looks like 4:30 a.m. after a hard night.



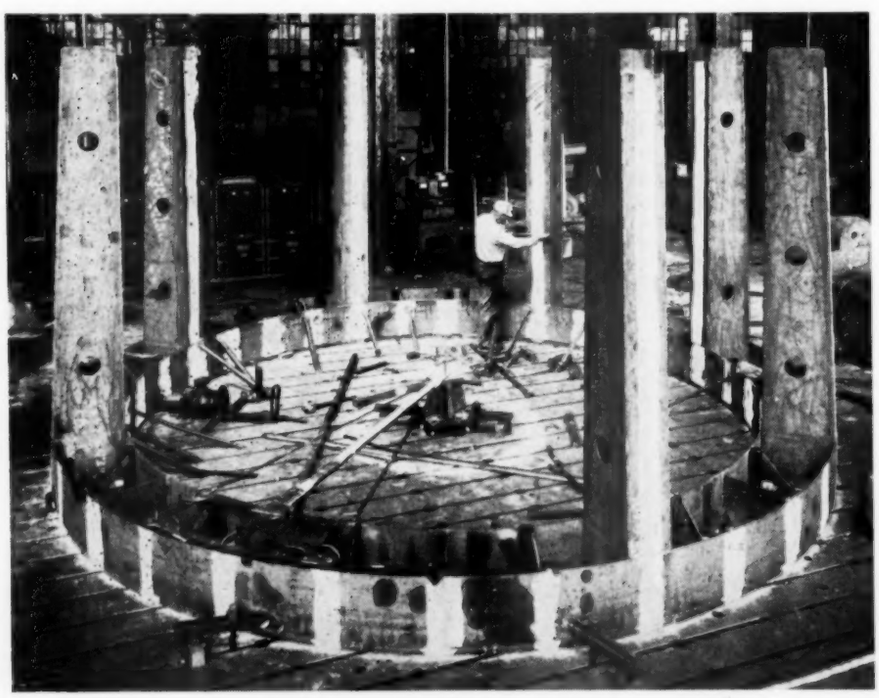
Artist's Conception of Completed Telescope in Observatory on Mount Palomar

Making a Mounting *for the* 200-Inch Telescope . . .

THE 200-in. telescope to be installed on Mt. Palomar in California will dwarf in size the 100-in. telescope on Mt. Wilson near Pasadena, which has held the world's heavyweight championship in the field of telescopes since 1918.

The new 200-in. telescope, although it has the dimensions of a 6-story building, and weighs 1,000,000 lb., is a precision instrument. Its essential optical surfaces consist of less than one ounce of aluminum and photographic emulsion. To permit these surfaces to function properly, some 35,000 lb. of glass and about 1,000,000 lb. of steel are used.

The steel forms the mounting of the telescope. The mounting consists of two parts—a tube, and a cradle or yoke which carries the tube. The tube of any telescope serves as a supporting structure for the principal optical elements. It holds these elements in fixed spatial relationship no matter how the tube may be oriented. These parts were manufactured in the Philadelphia works of the Westinghouse Electric & Manufacturing Co.



Fabricating the Prime Focus Cage.

(The lower main ring of the cage was formed on the floor plate, and the uprights (formed elsewhere as detail parts) assembled as shown. The ring is approximately 22 ft. in outside diameter and the cage is roughly 12 ft. long with the top ring in place. Note the gauge for controlling the proper radius and for accurately locating the pieces of tubing, also the simple method for supporting and clamping the ring both inside and out. Welding has certain advantages over other methods of fabrication when it comes to supporting and clamping down, since clamping blocks, struts, stays, etc. can always be attached exactly where wanted by welding and are readily removed later. The use of intermittent welding will be noted in most of the parts.)

Sub-Assemblies of Tube and Yoke Are Entirely Welded

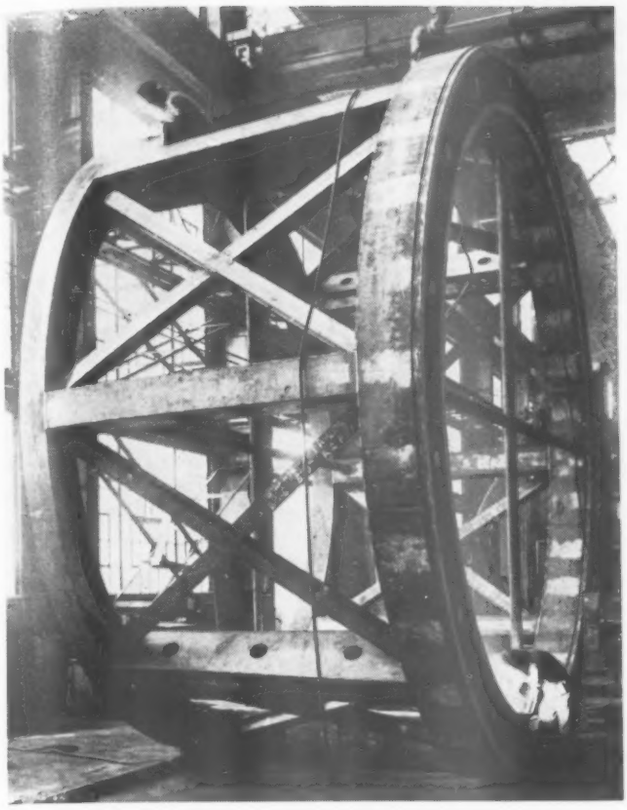
Both the tube and yoke are made of ordinary low-carbon steel. Each is made of several sections, of hollow-box construction, electrically welded. The separate sections are bolted together by means of internal bolt flanges. The sizes of the separate sub-assemblies were dictated by the size of the largest machine tools available in the fabricating plant.

The tube consists of 8 main parts—a mirror cell, a bottom ring, four central flat panels, a top ring and a diaphragm cage which supports the observer's cage at the main focus. These parts are connected by means of I-beam struts in the form of A-frames.

The tube is about 60 ft. long. It is square in the middle and round at the ends, having an outside diameter of 22 ft. It is thus as long as a 6-story house is high and has a diameter equal to the height of an ordinary 2-story dwelling. The tube, without optical parts, gears or mirror cranes, weighs about 200,000 lb.

The yoke is made in 10 main parts, these being hollow-box structures, electrically welded and bolted together. The "horseshoe" is made in three parts, each of which weighs around 120,000 lb., the assembly being 46 ft. in diameter. This forms, perhaps, the largest journal bearing ever constructed.

The side girders are tubes 10½ ft. in diameter and 50 ft. long, each girder being made in three sections. The center section of each girder houses the



Prime Focus Cage With Both Rings Welded in Place.

(The X members are formed from I-beams, which are joined by welding. Crossed tubular supporting members at each ring have been welded in place to securely hold the rings in shape during handling to and from the annealing furnace, and during annealing.)

large radial and thrust ball bearings which carry the declination trunnions. The connecting girder at the south end is one continuous hollow-box welded structure 46 ft. long.

The entire yoke is about 60 ft. long and 46 ft. wide, and weighs about 700,000 lb.

While the mounting for the new 200-in. telescope actually weighs eight or more times that of the 100-in. telescope mentioned above, it is completely dissimilar to that telescope in all its main dimensions and proportions. For one thing, the mounting of the 100-in. telescope is a riveted structure, whereas the 200-in. telescope, mirroring the changes which have come over structure designs since the World War, is completely welded.

Size Is Increased Without Sacrificing Rigidity

The problem presented was to design a mounting twice as large in general dimensions as the 100-in. telescope and at the same time to make it a stiffer and more rigid structure—two conditions which in general are mutually opposed.

This problem is solved by welding the mounting into a huge hollow structure which, having its materials on the outer periphery of the elements composing the mount, gives a great ratio between rigidity and weight.

However, greater size accompanied by greater stiffness can only be achieved by increasing transverse dimensions faster than longitudinal dimensions. This has been done in the 200-in. telescope. While the transverse dimensions of the tube have doubled, the length has increased only 33%.

And so with the yoke itself—by letting the tube extend beyond the throat of the "horseshoe," the yoke is maintained at 1.57 times the length of the yoke of the 100-in. telescope. Its transverse dimensions, however, are more than doubled, the center distance of the main side girders of the yoke being about 2.35 times as far apart as in the 100-in. telescope. With these general dimensions, if we assume that the metal thickness used will grow in proportion, the mounts of the 100-in. telescope and 200-in. telescope should be equally stiff—that is, should have the same static deflection. Actually, the 200-in. telescope has a smaller deflection (that is, it is stiffer) since 1-in.-thick plate is used in girders whose dimensions are such that the stiffness per unit length is over 100 times as great as it is in the 100-in. telescope. By using space which weighs nothing—that is, by distributing metal far from its neutral axis—stiffness and comparative lightness have been achieved.

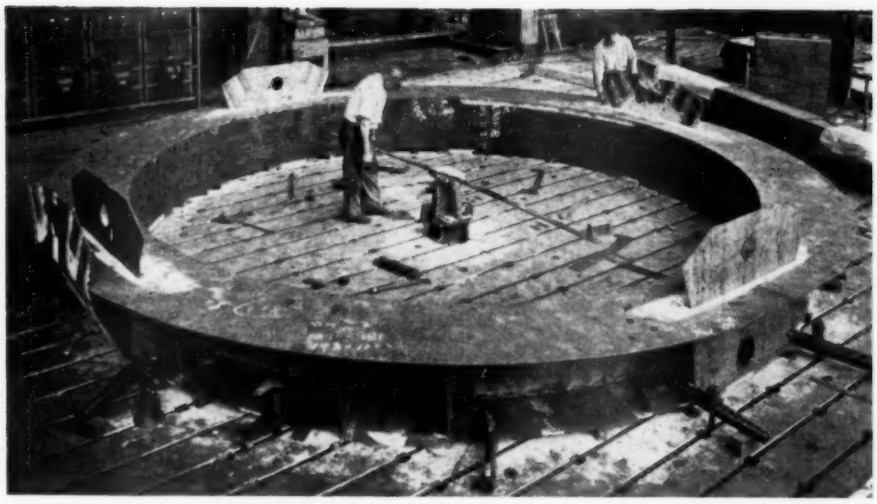
Hollow-Steel-Box Design Affords Stiffness

Thus the tube and mounting are made of hollow-steel-box welded structures—bulky sections which are very stiff but which have weights which are surprisingly small. Its bulk can be guessed from the pound per cubic foot or specific weight. The tube weighs only 8 lb. per cu. ft. (if it were enclosed in a box), the "horseshoe" 86 lb. per cu. ft., and the rest of the yoke 20 lb. per cu. ft. It is interesting to note that the largest condenser ever built by Westinghouse weighed 22 lb. per cu. ft. and an entire 175,000-kw. turbo-generator installation including condenser weighs about 50 lb. per cu. ft. Since a solid cubic foot of steel weighs 490 lb., it is seen that these structures have lots of empty space in them. The use of bulk in the telescope gives maximum stiffness with minimum weight.

A structure having a tube as high as a 6-story building, with a supporting structure of the same length and a width equal to the height of a 4½-story building, presents some difficult problems of manufacturing. In order to manufacture and transport this Gargantuan structure, it is first of all necessary to build it in sections the overall dimensions of which are limited by the

Welding the Upper End Ring of the Tube.

(This is the ring to which the prime focus cage will be secured. The ring is approximately 22 ft. in outside diameter. Methods of gauging, clamping, etc., are much the same as used with the prime focus cage. Two welders work on opposite sides simultaneously, to better distribute heating and cooling effects.)



Fabricating the Bottom End Ring of the Tube.
(The mirror is to be secured to this ring, which is about 22 ft. in outside diameter.)

size of available machine tools, including annealing furnaces.

Each section of the telescope tube and mount is a welded structure with machined, bolted joints to tie the contiguous parts together. Ordinary hot-rolled low-carbon steel plates and structural shapes are used, these being ideally suited to the welding process.

Special Care Exercised to Prevent Distortion

No essential difficulties exist in welding, since most of the plates and shapes welded are less than an inch in thickness. However, in the "horseshoe," the inner and outer peripheries being at least 4 in. thick, the problem of distortion during the welding process demands great care in design and fabrication procedure.

After the fabrication of each section, stresses must be relieved by annealing at 1150° F. to assure that the inevitable internal stresses caused by the welding will be relieved by plastic flow. Without this relief of internal stress, the sections would warp during the machining process, and they might even continue to warp over long periods of time after the telescope was assembled.

The largest, although not the heaviest, single element in the whole telescope design is the diaphragm cage which forms the top of the tube. This piece is 22 ft. in diameter and 12 ft. high. No furnace at Westinghouse or neighboring plants was big enough in cross-section to handle this piece. Even if a furnace of proper dimensions existed in the neighborhood, the piece could not have been transported by rail or truck, since clearances on railroad or street are not great enough to let the cage pass. A special furnace, therefore, was constructed to anneal this cage and other large pieces. The cage, while very bulky, weighs only 26,000 lb.

The heaviest single piece of the mounting will be the center section of the "horseshoe," which will weigh close to 120,000 lb. The assembled "horseshoe" with its balancing pieces will weigh 400,000 lb.

The tube, which will weigh 150,000 lb., is to be lined up in the Westinghouse shops and shipped in one piece to the Pacific Coast. The lining-up process will be no more difficult than a job of lining up a large turbine. The tube, 22 ft. in diameter and 50 ft. long, would tax the space limitations of most shops.

Naturally such a large unit can only be shipped to the Pacific Coast by water. It requires a great deal of head and side room. Fortunately, the Pennsylvania Railroad branch which runs into the plant can furnish an exclusive right-of-way long enough to carry the tube slung in its shipping cradle to the docks at historic Fort Mifflin. There the great army of loading cranes will lift the 100-ton burden onto a ship or transfer barge. The transfer of this huge telescope tube from dock to ship will perhaps be the most unusual scene witnessed at this old Revolutionary Fort since the British bombarded it 160 years ago. The tube will finally become the deck load of some coast-wise steamer to be delivered to San Diego in California.

The rest of the job will be shipped in pieces which are less bulky, but still so large that water shipment will be necessary in most cases.

From the dock in San Diego these same pieces must be transported over some 60 or 70 miles of road and up Mt. Palomar. Huge trucks such as were used on the Boulder Dam project will be necessary. A special road is being built up Mt. Palomar to permit the transport of the telescope and related materials.

Welding and Annealing the Telescope Parts

By NORMAN L. MOCHEL
Metallurgical Engineer, Westinghouse Electric & Manufacturing Co.

THE extensive use of arc welding in the construction of the tube and mounting of the 200-in. telescope for Mt. Palomar is an outstanding example of the confidence in the welding art that has been developed in the minds of engineers in many fields of activity.

There is nothing of an experimental nature in the adoption of welded construction for the various members of the telescope. Other structures of comparable size and complexity, and like value and importance, have been successfully produced by this method.

In the case of the telescope, steel plates, bars, structural shapes and a few steel forgings have been welded together to form the member parts. The size and shape of these member parts, though naturally reflecting the general design, have also been influenced by such practical considerations as the availability of material, machining facilities, transportation, and the necessity for minimizing internal stresses and resulting distortions.

It must be understood that the various member parts are prepared by machining for bolting together at Mt Palomar. Frequent references to all-welded construction may have given the erroneous impression that member parts were to be joined on location by welding. It is true that in many large engineering structures, member parts have been and are being joined by welding on location. However, in such cases, invariably the construction and intended service are such as to tolerate distortions that would take place during welding or during the useful life of the apparatus, or to cause no concern over the presence of variable and unknown degrees of internal stress. Obviously such conditions could not be tolerated in the construction of these telescope parts.

Material Consists Mostly of Mild Steel

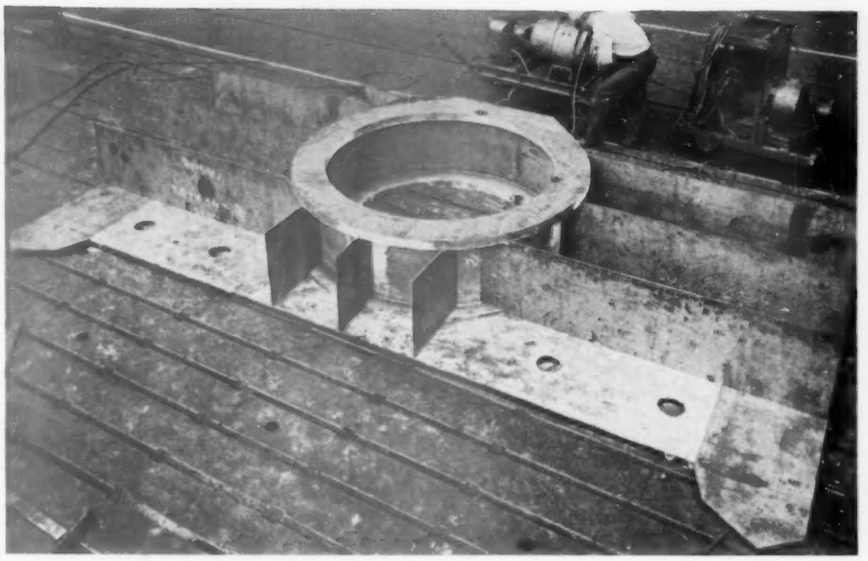
In any discussion of welding, one is naturally interested in the materials that are to be used and that must submit to

welding. Again, one encounters an erroneous impression, that a telescope must be constructed largely of special alloys that have low expansivity. While it is true that some materials of this type are used in connection with the mirror and other optical parts, most of the material used for the tube and mounting is ordinary mild steel. All the materials to be welded are of standard commercial grades that are being welded day in and day out.

In all cases, plates, bars and structural shapes have been rolled by one supplier from specially selected heats, to give the greatest possible uniformity of composition.

Plates less than 1½ in. thick were made of the usual flange quality of steel plate, similar to that covered by A. S. T. M. Specification A-70. All such steel for the tube was made from a single heat, specially melted for the purpose.

Plates 1½ in. thick and greater were rolled from silicon-killed steel poured into hot-top ingots, to guarantee soundness of section. This steel is similar to grade "A," A. S. T. M. Specification A-150.



Manufacturing One of the East and West Panels.

MATERIAL FOR TUBE	C	Mn	P	S	Si
Plates under 1½ in. thick	.10	.40	.016	.034	.16
Plates 1½ in. thick and over	.24	.50	.009	.023	.25
Bars	.09	.39	.016	.025	.18
	.09	.38	.016	.030	.05
	.09	.46	.016	.043	.03
	.09	.40	.016	.035	.05
	.16	.45	.015	.036	.08
	.12	.40	.010	.030	.04
Structural shapes	.10	.40	.011	.036	.12
MATERIAL FOR "HORSESHOE"					
4½-in. and 4-in. plates for main part (inner and outer bands)	.22	.50	.031	.028	.22
	.24	.44	.016	.027	.19
Plates 1½ in. thick and over	.23	.56	.015	.032	.26
	.24	.53	.014	.029	.25
	.24	.47	.016	.031	.25
	.24	.47	.018	.023	.27
	.27	.54	.015	.027	.26
	.25	.48	.011	.022	.27
Plates under 1½ in. thick	.11	.42	.013	.023	.16
	.10	.42	.011	.028	.16
	.12	.32	.016	.020	.16
	.10	.43	.013	.025	.16

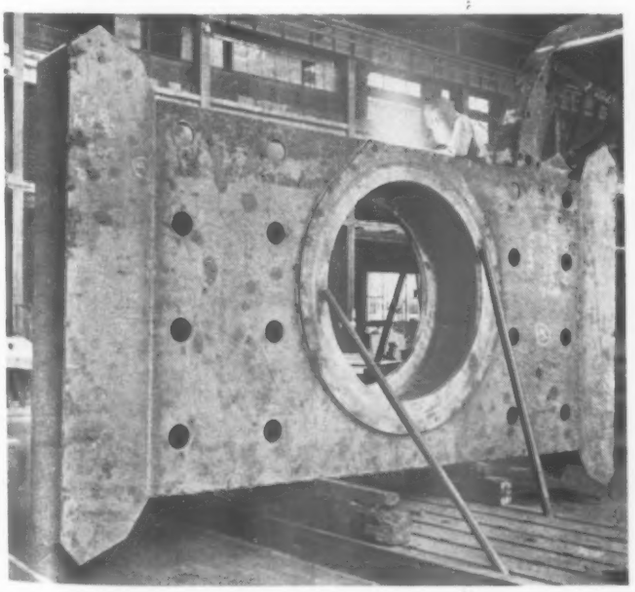
Two carbon-molybdenum steel forgings are used in building up the declination bearing housing.

The uniformity of composition of the steel used in the tube and "horseshoe" is shown by the table at the left.

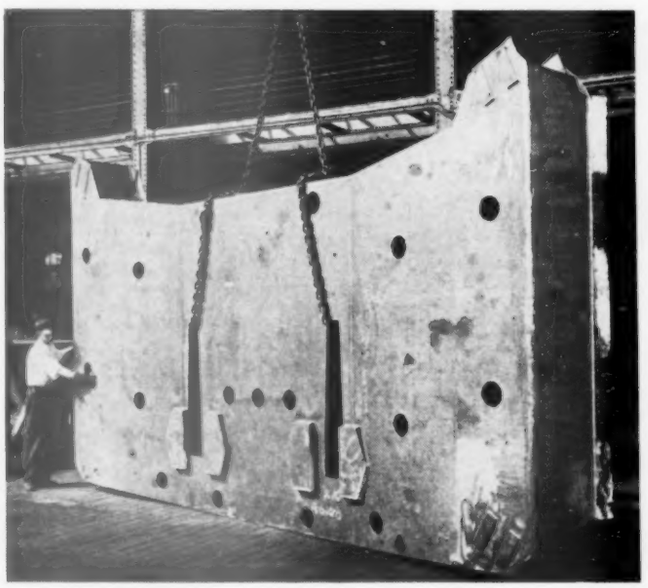
It is interesting, in connection with the materials used, to note that each outer band for the three sections of the "horseshoe" required a piece of plate 4½ in. thick, 60 in. wide and 47 ft. long. These pieces were accurately formed to desired curvature under a 12,000-ton forging press.

Arc welding only has been employed and, in all cases, heavily coated electrodes of the mineral-coating or slag-producing type were used. These were of but two makes; both of the highest quality available.

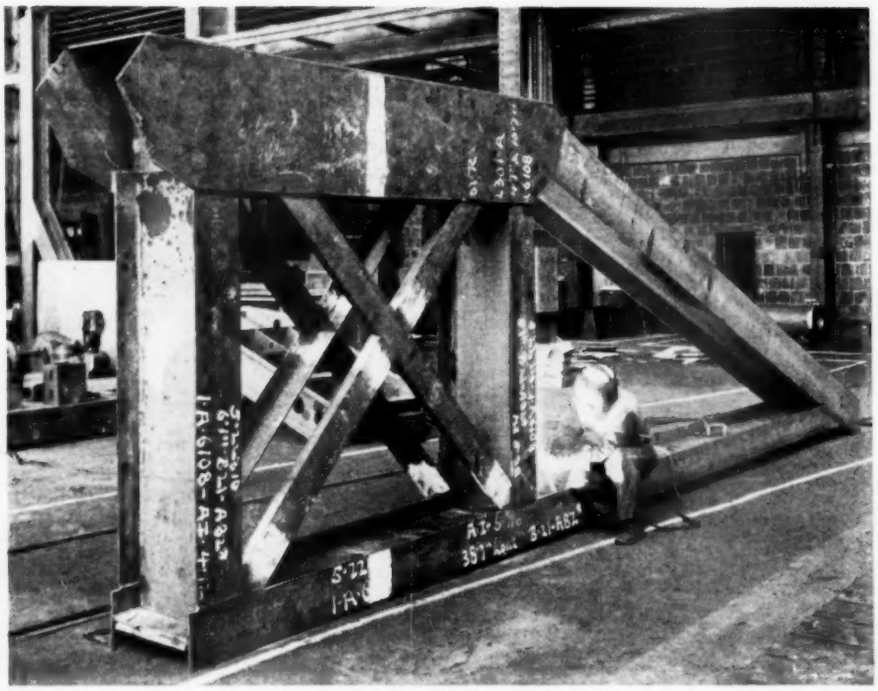
It is well recognized today that electrodes can be devised that will best meet some given condition of deposition. Full advantage of this has been taken, and



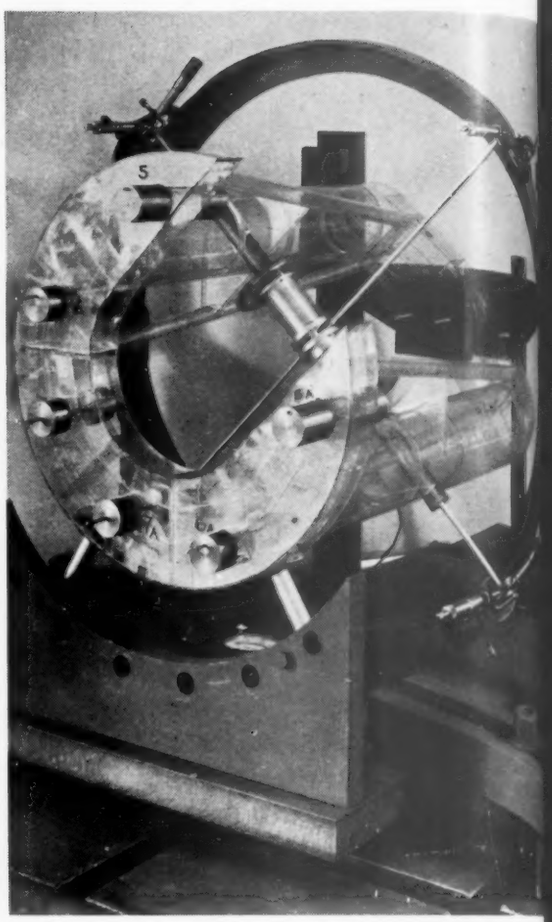
An East and West Panel With Welding Practically Completed.



Completed North Panel of Tube.



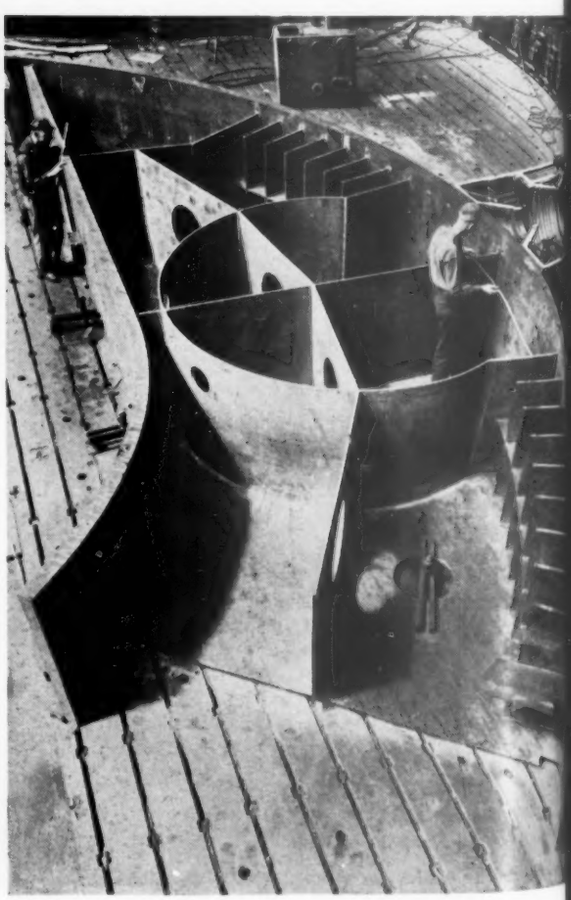
Portion of South Panel of Tube.



Measuring Deflections of a Celluloid Model of the Y
(Accurate readings were obtained by indicating micrometer ca
trically.)

Fabricating One of the End Sections of the Yoke "Horseshoe".

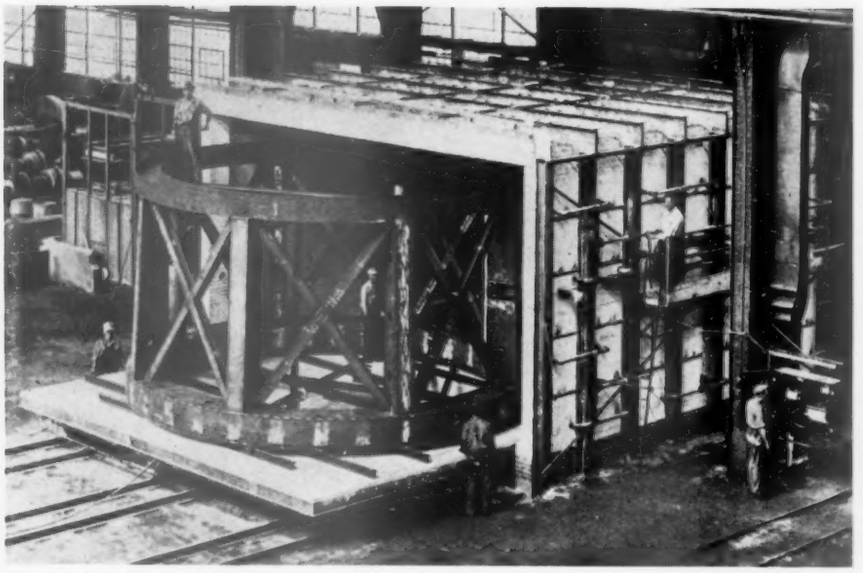
(This "horseshoe" has an outside diameter of approximately 46 ft. The plate forming the outer band is 4½ in. thick, 60 in. wide and 47 ft. long. The one side plate was formed first. A careful examination reveals two circular lines of welding in the side plate (or bottom plate in the position shown). This is a ring 10 ft. in diameter and 3½ in. thick, to which the 10-ft.-diameter yoke tubes of the telescope will bolt. The ring has been welded into the 1-in.-thick plate, flush on the inside as shown. The side plate was clamped down and the inner and outer bands moved into position as shown.)



(Right) Further Progress in Fabrication of End Section of "Horseshoe"

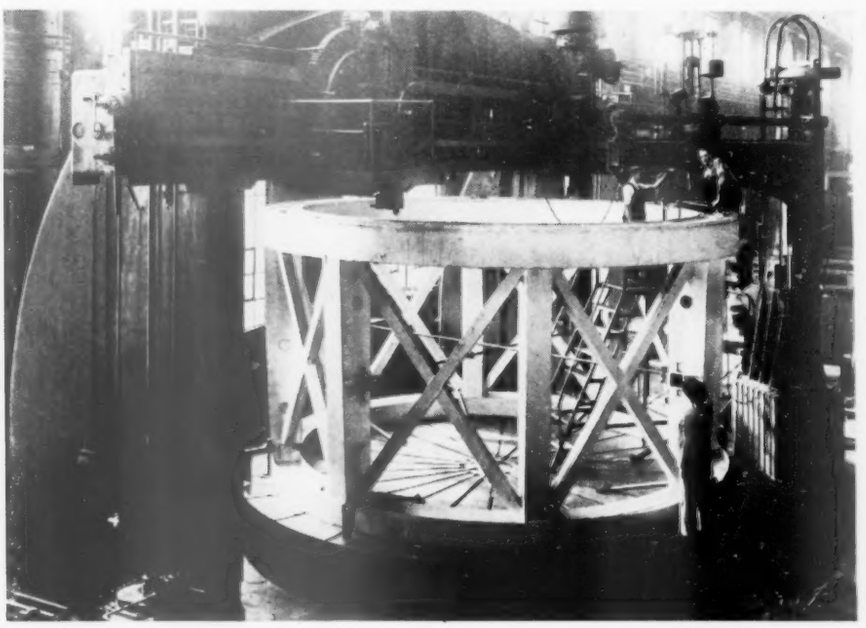
(The inner and the outer bands were clamped in position by means of clamping blocks welded to them, as shown. The internal plates, reinforcing members, etc. were fitted in place and secured by tack welding. After properly fitting the cellular or box-like structures that fasten to the outer band, and fixing the various component parts by welding a bar across them, they were removed from the main part and welded under the most ideal conditions on the floor. This had a double advantage. It permitted turning them in any position to get the best welding, and it avoided undue heating and stressing of the main members by the considerable amount of welding necessary. There were five of these sub-assemblies; two are shown in place and spaces for the other three are in evidence. While this was under way, welding was carried out on the larger reinforcing members. All welding was started at the center, working outward. The illustration shows the welding of these members practically completed, after which the five sub-assemblies are moved back into position and welded in place. Two stress-relieving treatments will be applied, one before the other side plate is installed and one upon the fully completed structure.)

mpleted Tube Which Will Carry 200-In. Telescope.

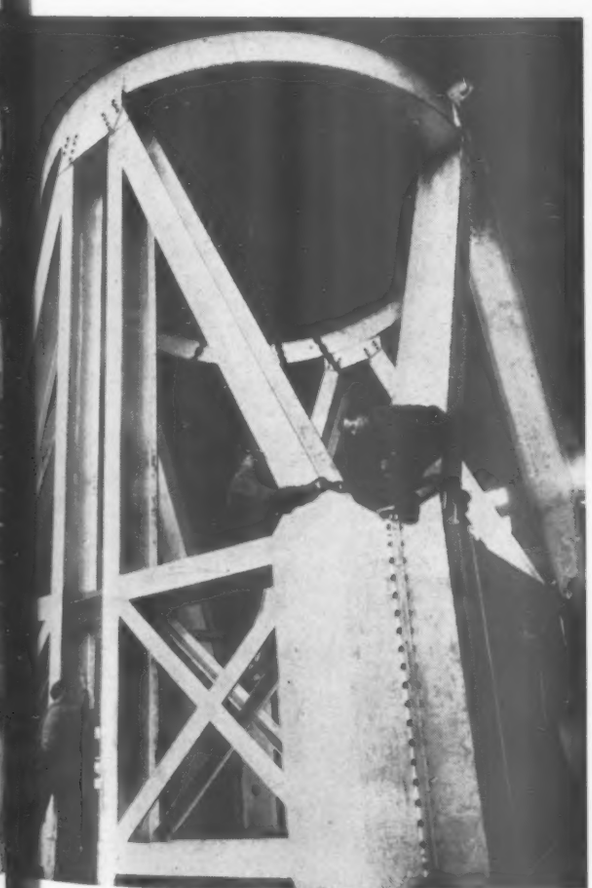


Moving Prime Focus Cage Into Furnace for Stress Relieving.

(The furnace shown was especially constructed to anneal the telescope parts. The work rests on a car-type bottom for ease of operation. A special type of gas burner was used that gives a quiet-acting flame and avoids long, hot flames impinging upon the work. Burners are also located in the truck or car at the front of the furnace to avoid a "cold" spot at the front. The door or front cover of the furnace is made in sections that hang from the roof and tightly seal the furnace. Baffles of heat-insulating bricks were built up at four points where the circumference of the cage came too close to the walls and the burners, to prevent undue or rapid heating at those points. Thermocouples were in actual contact with the work, and continuous autographic records were made from four thermocouple locations throughout all annealing periods. To prevent the crossed members from sagging and possibly distorting the ring sections during annealing, additional tubular members were placed in an upright position between the crossed members. Also, blocks were placed on the car floor underneath the lower crossed members to prevent their sagging. Supporting of support members is just one item of the care that must be used in such work.)



Prime Focus Cage Placed on 32-Ft. Boring Mill for Machining Ring Joint.



(Left) All Parts Comprising Tube Assembly Held Within Close Tolerances.

(In the bolted joint of the two panel sections in the lower right-hand corner, the two flanges had not been machined on the edge or outside surface, yet at no place in four such joints was there more than $\frac{1}{16}$ in. difference between two mating flanges along these outside unmachined surfaces, and, in general, the joints were much closer than this figure. The joint faces were, of course, machined to a definite fit. There was very little difference in thickness of the mating flanges. Moreover, when the top ring was lowered into place, the four gussets that bolt to the A-frames were found to be accurate as to position within approximately $\frac{1}{16}$ in.)

three kinds of electrodes, as regards position of deposition, have been used. One was used for all down-hand butt welds; another for all down-hand or horizontal fillet welds; and yet another for welds that of necessity had to be made in a vertical position. Overhead welding has been avoided.

Welders Are Qualified Under a Variety of Codes

In our regular work at South Philadelphia, we are called upon to qualify our welders to a variety of codes and specifications. For example, we have had construction under way on our floors at practically the same time requiring that we meet the ASME Boiler Code for Unfired Pressure Vessels, and API-ASME Code for Unfired Pressure Vessels for the Petroleum Industries, the U. S. Navy, the Bureau of Steamboat Inspection, the American Bureau of Shipping, the ASA Pressure Piping Code, and the requirements of two well-known insurance companies. Of necessity, we have developed all-inclusive codes and process specifications of our own, so that qualification under our own more extensive requirements qualifies an operator to perform under any of the above codes and specifications.

Operators performing welding on the telescope tube and mounting have qualified under the outlined system, and are welders of the highest type.

The welding electrodes used are of such nature that they behave equally well with d.c. and a.c. welding apparatus. Both d.c. and a.c. units are available, and both have been used throughout. A.c. welding was found to be especially useful for welding into corners.

All welding on the tube parts and to date on the "horseshoe" has been manual welding. The two declination bearing housings were produced using automatic welding for the longitudinal and external circumferential welds.

In welding such large parts as those described, careful study and planning of the work are very important. There is a best place to start, and a best sequence of operations. One does not have an opportunity to practice with a first few and thus develop a final technique. There are no trial pieces to be thrown away. In the case of some parts, there is but one piece of a kind to make; in others, there are two like pieces.

Assembly and Welding Require Heavy Leveled Floor Plates

For welding such large structures as those under discussion, large leveled floor plates are of absolute necessity. The need for ample space, for proper supporting, and for a firm foundation will be obvious from an examination of a number of the illustrations accompanying this article.

All the telescope parts are carefully annealed to relieve internal stresses. It is standard practice to stress-relieve welded mild-carbon-steel structures by heating slowly in a suitably constructed furnace to a temperature between 1100° and 1200°F., holding for a period of time proportioned on the basis of at least one hour per inch of thickness and then cooling slowly in the furnace.

Welded Assemblies Are Given a Double Cycle of Stress-Relieving

In order to thoroughly stress-relieve the telescope parts, we have used a double annealing cycle, heating to 1150° to 1200°F., holding for a period of three hours for the first one inch of thickness plus an additional hour for each additional one inch thickness or fraction thereof, followed by a slow cooling in the furnace until the temperature has fallen below 600°F., and then repeating this cycle in its entirety and cooling below 300°F. before the furnace doors are opened.

The following summarizes the heat-treatment of the prime focus cage as an example:

12 hours heating to 1160°F.
6 hours holding at 1150° to 1160°F.
11 hours cooling to 600°F.
10 hours reheating to 1150°F.
6½ hours holding at 1150° to 1160°F.
42 hours cooling to 125°F.

Dimensions of Assemblies Are Held to Close Tolerances

A check of the accuracy of fabrication of the prime focus cage showed the departure from roundness to be not greater than 1/16 in. for one ring and 3/32 in. for the other. A high degree of accuracy was also found in the parts that make up the assembled tube.

All parts are carefully cleaned by sand blasting prior to painting. A priming coat of aluminum paste in varnish is first applied. This has been considered more desirable than a red- or blue-lead or a red-oxide primer, so that as scratching occurs in handling or later in service, the objectionable appearance of blue or red streaks will not be in evidence. A high-grade eggshell synthetic resin enamel of light gray color will be used for the second coating and will give a pleasing appearance.

Navy Bows to Housewife as Consumer of Steel

The peaceful activities of a single refrigerator manufacturer last year accounted for twice as much steel as the United States Navy needs to complete a half-dozen destroyers and three cruisers now under construction, according to figures revealed recently by B. P. Watkins, director of purchase for the Kelvinator Division of Nash-Kelvinator Corp. Mr. Watkins listed steel purchases for Kelvinator as in excess of 50,000,000 lb.

During the past year electric refrigerators, ice cream cabinets and other products manufactured by the Kelvinator Division of Nash-Kelvinator Corp. used 1,500,000 lb. of copper strip and sheet, 1,500,000 lb. of copper tubing, 1,000,000 lb. of brass sheet and strip, 200,000 lb. of aluminum, 12,000,000 board feet of lumber, and 1,900,000 lb. of porcelain material. The copper tubing alone is enough to stretch over the 850 miles from Chicago to New York.

Half Million Tack Welds on Golden Gate Bridge

The Golden Gate Bridge at San Francisco, along with its many other "supersized" construction operations, is the site of one of the largest shop and field welding operations on the Pacific Coast. This job, which covers the fabrication

Tack Welding Steel Fabric Trusses to Floor Stringers.

of "steel fabric trusses" and the welding of these trusses to floor stringers on the bridge, is being handled by twelve arc-welding machines, reports the Harnischfeger Corp., Milwaukee, Wis.

The Concrete Engineering Co., which is under contract to fabricate, deliver and place these trusses in the bridge, has divided its field of welding activity into two distinct operations. Operation "A" includes all the shop work entailed in fabricating approximately 1,800 tons of welded trusses. About six months' time was required for this work. Operation "B," which includes all field work, covers the tack welding of these trusses to floor stringers in the bridge.

The trusses have a depth of approximately 5 in., and are spaced 6 in. on centers. Over half a million 1-in. tack welds were required during a period of about 75 days, this work being in charge of Welding Service Sales, Inc., of San Francisco.

Spraying *with* Molten Metal

Street-Crossing Lines

Four and a half years ago, four traffic lines were metal-sprayed for a short distance on a Los Angeles boulevard, for testing the durability of this application to traffic lanes. Each sprayed line was 5 in. wide and 10 ft. long, across the line of automobile travel. Four metals were used. A recent inspection, recorded in the *A.E.D. Bulletin*, issued by the Air Reduction Sales Co., 60 East 42nd St., New York, N. Y., revealed that the copper-sprayed strip was all gone, the aluminum strip had about 80% remaining, the bronze about 70%, while the zinc strip was as good as when applied. Corrosion had turned the zinc strip to a dark steel gray. The concrete road was not prepared in any way before being sprayed.

* * *

Reclaiming Pump Rods

Worn pump rods and plungers are economically reclaimed by metal spraying with any one of a number of steels. Stainless steels of both the 18-8 and air-hardening types are used where corrosion is present, and high-carbon steel is applied primarily for resistance to wear. A lot of twelve, 1 15/16-in.-diameter worn rods from pumps in refinery gasoline service were recently built up with 18-8 stainless steel by the Metalspray Co., Inc., 113 Llewellyn St., Los Angeles, Calif.

Approximately 3½ lb. of ⅛-in.-diameter wire was applied to each rod over a worn length of about 24 in. to give a coating 1/32 in. thick at the finished size. The rods were finished by wet grinding, and approximately 0.030 in. on the diameter was allowed for this. The time and material cost, including preliminary machining involving undercutting and rough threading, and spraying and grinding, was less than $8 for each rod. Similar pump parts in sizes ranging up to 6 in. in diameter and more have been reclaimed by spraying with monel metal.

High-carbon steel and air-hardening stainless steel as sprayed are too hard to be finished by lathe tooling and must be ground. Stainless steel of the 18-8 variety, and monel metal, can be easily cut with the commonly used grades of high-speed steel, but it is recommended that whenever possible these metals be finished by either wet or dry grinding, since the corrosion resistance of these materials is somewhat enhanced by the resulting highly polished surface.

Excellent results may be obtained, however, where grinding equipment is not available, by simple lathe turning followed by emery polishing. Finishing methods in the order of preference are: wet grinding, dry grinding (portable lathe tool-post set up), and lathe tooling with emery polishing.

* * *

Coating Coil With Lead

Metal spraying in its various ramifications is of major interest to the chemical and allied industries, and many excellent applications involving corrosion-resisting metals have been developed during the past few years. A typical example is an evaporator coil that was sprayed with metallic lead for protection against the corrosive action of a hot aluminum-sulphate solution. The work was performed for a large western chemical plant by the Pacific Coast Engineering Co., West 14th St., Oakland, Calif.

The coil was constructed of heavy-walled copper tubing, the main body of the unit consisting of two banks of 16 2-in. diameter by 6-ft. long tubes each, connected at the top to two 4-in.-diameter headers, and at the bottom to a single 5-in.-diameter header.

Each bank of the coil was made up separately, one section consisting of a top header, tubes, and bottom header, and the other section of a top header and tubes. Service conditions called for a structure that would withstand an internal steam pressure of 75 lb. per sq. in. and a temperature of 460°F. A satisfactory type of joint was made by brazing all connections, using a special phosphor-bronze rod.

The two sections were heavily blasted with 12-14-mesh angular steel grit to clean the copper and to develop the character of surface necessary for the proper bonding of the lead. Each bank of tubes was then sprayed with ⅛-in.-diameter lead wire to produce a coating in excess of 1/16 in. thick. The sprayed sections were assembled to form the complete unit, and the top and bottom joints brazed. After a hydrostatic test the uncoated areas in the vicinity of the joints were grit blasted, and then sprayed to complete the lead covering.

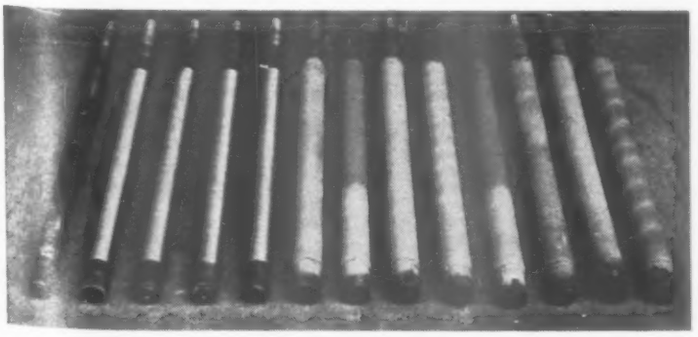
Sprayed lead in thicknesses of 0.010 to 0.060 in. has definitely proved itself equally as effective as other forms of lead in resisting the attack of many types of wet and dry sulphur gases, sulphuric acid, and sulphate solutions. The weight of metal applied depends mainly on the severity of the service, but when immersed conditions prevail, a minimum of about 0.025 in. of lead is necessary to obtain a fluid-tight coating.

Lead may be applied to any type of metal after its surface has first been suitably prepared by heavily blasting with an angular abrasive. Sprayed lead is fully supported by the base metal upon which it is deposited, and hence structural considerations as regards a lead lining in a tank or chamber, for example, are eliminated. The coating need only be thick enough to resist the existing corrosion and to care for any possible accompanying abrasive action.

Engineers are appreciating the fact that the relatively thin sprayed lead coating, intimately bonded to the underlying metal, gives a composite structure that has a greater heat conductivity than that where thicker, loose-fitting lead cov-

Spraying Single Bank of Tubes.

Spraying Joints After Assembly.



Pump Rods Built Up With Stainless Steel.

erings are used. This means that important increases in production or substantial savings in fuel can be effected in the operation of heat-transfer and similar equipment where protection from corrosion is required. An excellent example of this is the above-described evaporator coil.

A. W. S. Sections Elect New Officers

Recent elections held by a number of American Welding Society Sections have resulted in the following new officers:

Boston Section—Chairman, P. J. Horgan; vice-chairman, W. L. Warner; secretary-treasurer, P. N. Rugg.

Maryland Section—Chairman, J. W. Miller; vice-chairman, C. M. Underwood; secretary-treasurer, G. N. Harbinger.

New York Section—Chairman, R. W. Boggs; first vice-chairman, J. L. Edwards; second vice-chairman, E. Tangerman; secretary-treasurer, Milton Male.

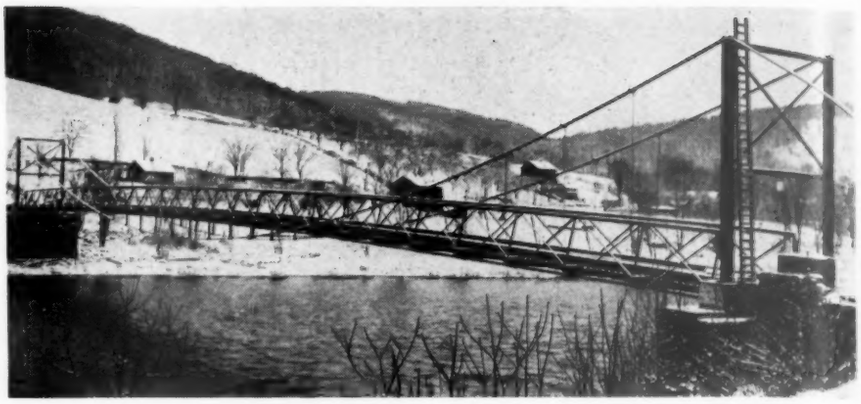
Philadelphia Section—Chairman, T. M. Jackson; vice-chairman, Ed. G. Hosted; treasurer, R. D. Thomas; secretary, H. E. Hopkins; junior past chairman, C. I. MacGuffie.

50-Year-Old Bridge Rebuilt by Welding

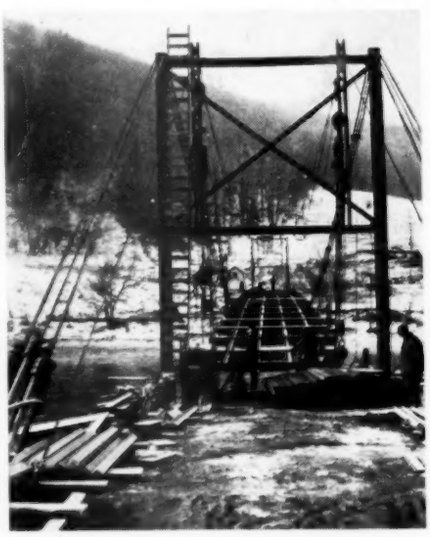
Extensive modernization work on the 50-year-old interstate Kellam-Stalker suspension bridge over the Delaware River near Hankins, N. Y., was recently completed by welding. The old wooden stiffener trusses and towers were replaced with welded steel, and the wood floor with Blaw-Knox open-mesh welded decking.

The entire superstructure of the bridge, including the old stone anchors, was completely dismantled. The old 2⅛-in. galvanized cables, of which there were four, were found to be in excellent condition, and even after 50 years' service showed no signs of deterioration or no permanent set at the towers. These cables were used on the new structure, two on each side, and one new cable was added to each side. Special clamps were designed to carry the hangers from the three parallel cables.

In order to prevent any disturbance to the main line of the Erie Railroad, which runs within a few feet of the anchorage on the New York side of the bridge, and to prevent any future settling of the fills, sheet steel piling was used and left in place. The concrete was poured directly against this sheeting. The tops of the old stone masonry piers were removed to a good, solid material and recapped with concrete, and concrete was used to replace the old stone anchors.



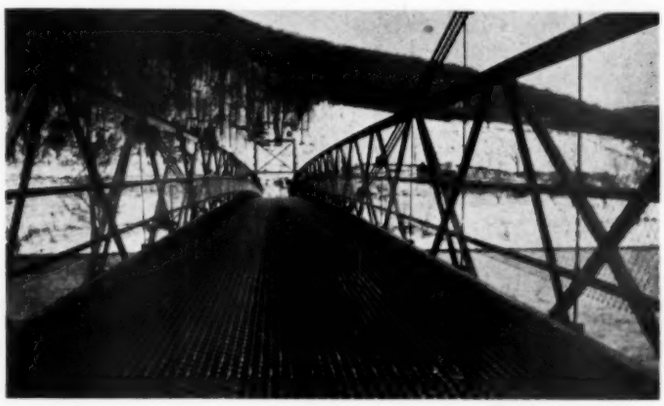
This Welded Bridge Replaced a Wooden One.



The Towers Also Were Welded.

The new stiffener trusses and towers were shop welded in sections, and the sections were field welded together after having been erected by means of a twin cableway, one over each stiffener truss. All stringers, floor beams and cross ties were field welded with ⅜- and ¼-in. fillet welds. The open-mesh bridge decking was made continuous with cold-driven rivets, and field welded to the cross ties with 1x¼-in. fillet welds. All welding was done by the shielded-arc process.

Designing of the bridge was by the Pennsylvania State Highway Department, for the Pennsylvania-New York Interstate Bridge Commission. Erection, welding and field work were done by Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.



Open-Mesh Bridge Decking Welded to Cross Ties.

Wood-Splitting Machine Is Entirely Welded

Welding has made possible the construction of a unique machine which has proved a great labor-saving device in Southern California in the production of domestic stove and fireplace wood. Much of the wood used in that part of the country is eucalyptus—one of the toughest of woods to split, because of its hard and twisted grain. Blasting has been resorted to in this work, but at best it is slow as well as expensive.

The all-welded wood-splitting machine shown herewith was designed and built by R. L. Shaffstall, welding-shop owner of El Monte, Calif., for Lockwood Brothers, local fuel producers.

Made of 20-in. I-beams, the frame is mounted on an old truck chassis. The unit is driven by a White truck motor equipped with large stationary-engine flywheels, with belt and pulley drive, the power being controlled by a hand lever (shown just above the truck wheel) and applied by means of a friction clutch on the flywheels.

The splitting blade is made of two pieces of 1-in. boiler plate, 16 in. wide and 30 in. long. It has a bit about 8 in. long made of tempered plow steel, which is removable for sharpening. The main blade is designed at the lower end to allow the bit to be inserted and secured between the two sections of plate forming the blade. The bit is secured by

Tough Wood Is Readily Split.

means of three 1-in. steel pins. Holes are drilled at different points in the blade (as seen in the illustration) to provide for proper application of the power and to give the right leverage for different types of wood.

The blade beam is made of 8-in. angle iron, while a wooden guard at the top prevents accidents to workmen as the beam passes up and down.

Welding was employed extensively in the building of this unusual machine. The unit operates economically, adequate power being available at all times for splitting the largest and toughest block of wood yet attempted.

Large Enrollment at Wisconsin Conference

An enrollment of 480, besides many students, was registered at the welding conference held at the University of Wisconsin, at Madison, on April 29 and 30. In addition to an excellent papers program, which was published in last month's *The Welding Engineer*, 16 companies cooperated with the University in displays and demonstrations of equipment and processes.

Awards Contract for Second Huge Welded Tanker

The Atlantic Refining Co. has awarded to the Sun Shipbuilding & Dry Dock Co., Chester, Pa., a contract for the construction of a second all-welded 18,500-ton tanker, to be completed for delivery in September, 1938. The all-welded tanker of the same tonnage now being built for The Atlantic Refining Co. in the Sun shipyards is scheduled for delivery before the end of this year. The two Atlantic tankers are the world's largest welded ships now under contract.

The tanker for which the contract has just been awarded will have a cargo capacity of 156,000 bulk barrels of gasoline, and will be equipped with cargo discharge pumps which will enable it to discharge its cargo at the rate of 15,000 barrels an hour, approximately three times the usual discharge rate of from five to six thousand barrels an hour. The vessel will be 521 ft. long between perpendiculars, and will have a beam of 70 ft. Turbo-electric engines developing 5,000 hp. will give it a speed of over 13 knots, enabling it to make the trip between Philadelphia and Texas gulf ports in the unusually fast time of six days.

Thermit Repair Quickly Restores Cable-Car Service

To provide satisfactory surface transportation over the steep hills north of Market Street in San Francisco, the Market Street Railway operates a cable-car system. Five cable lines are driven from a central power plant, in which propulsion cables are wound on sheaves mounted on two large shafts. The shafts are driven through herringbone gears having a diameter of 14 ft. and a face of 24 in. The shafts are 18½ ft. long and approximately 12 in. in diameter. Each assembly weighs 52,000 lb.

About three years ago a break in one of the shafts paralyzed the entire cable system but, by means of thermit welding, an emergency repair was made and operation was restored after a shut-down of only 37 hours, the story being given on page 29 of the March, 1934 issue of *The Welding Engineer*.

Recently this same shaft failed again on the opposite side of the gear, several feet from the previous weld. The shaft was in operation for some time before the break was discovered, and during this time the first weld carried the weight of the gear as well as the operating load. Ample proof of the strength and soundness of the original weld was thus provided. As in the first instance, the break was so located that a thermit repair could be made without dismantling the shaft, and, although a new shaft was available, a four-day shut-down would have been required to install it. Therefore, to save time thermit welding was again decided upon.

Starting work at two o'clock in the morning, the welding crew, under the supervision of F. N. Keithley of the Metal & Thermit Corp., set up the mold box, prepared the mold, preheated the shaft for six hours and poured the weld by noon of the same day. After allowing another six hours for the shaft to cool, the mold was stripped away and the gates and risers were removed in ample time to permit replacement of cables and the resumption of operation at the usual five o'clock hour the following morning. Actual working time was four hours less than on the previous occasion, which had been considered something of a record. Two crucibles were employed in making the weld, and 250 lb. of forging thermit was used.

The repair was made under the direction of W. D. Chamberlain, superintendent of maintenance of the Market Street Railway Co.

Pouring the Thermit in the Mould.

Completed Thermit Repair.

Honors Conferred by Franklin Institute

Several engineers who have made important contributions to the development and use of welding will receive medal awards of The Franklin Institute, Philadelphia, Pa., on May 19, though all awards are for contributions not related to welding. Among the many who will be so honored are Herbert L. Whittemore, of the National Bureau of Standards, who will receive one of the Edward Longstreth Medals, and Inge Lyse, of Lehigh University, who will receive the Louis Edward Levy Medal.

Repairs Broken Pump Frame in Place

A broken frame of a high-pressure oil elevator pump at the Cupples Station branch of the Union Electric Light & Power Co., St. Louis, Mo., presented a difficult problem of repair. The break was on one side of the frame at the bearing point—an exceedingly difficult place to get to with the torch. Also the proximity of bearings and piston to the fracture subjected these parts to possible damage during the process of weld-

ing. Dismantling the huge pump would have necessitated too much time and labor. The job of making the repair fell to John H. Baumann, head of the St. Louis Welding Co., 4011 Forest Park Blvd., St. Louis, who solved the problem by building a preheat fire above the piston rod and attaching a flexible tip to his torch. The latter accessory enabled him to reach the break without imitating a contortionist. The job required 35 lb. of cast iron rod and 8 hours actual welding time.

Torch-Cut Yokes Correct Weakness in Casting

By ELTON STERRETT

Twin strainers were used to take crude oil under a line pressure as high as 1,000 lb. per sq. in. and clean it for circulation through the bearings of the centrifugal pumps being used to put up this initial pressure in a main-line crude-oil pumping station.

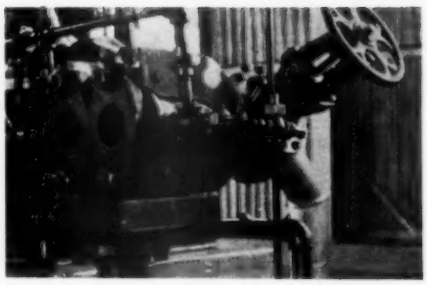
The clean-out cover over each set of strainer bowls was held in place by nuts and washers on two 1¼-in. eye-bolts, being pulled up tightly against a hard-fiber gasket to provide an adequate seal against the high-pressure being carried. The bolt was held by a 1-in. steel bar passed through the eye and locked by set screws in holes drilled through the ears on the main strainer casting.

Owing to the strainer design, it was possible for a careless station operator to tighten one nut in advance of the other, thereby forming a system of compound levers exerting tremendous pressure as the other nut was pulled up. So severe was the strain put on the castings in making the cover tight after each of the cleanings (4 hours apart) that it was only a question of time until the casting ears failed.

The breakage threw one centrifugal out of service, cutting the effective capacity of the pipeline one-third, and a welder was hastily summoned to build up the ears by brazing or welding.

Recognizing the inherent weakness of the casting design, the welder offered an alternative solution of the problem. Given his chance, he fitted a cardboard template around the end of the strainer casting and from it cut with his torch a C-shaped yoke from 9/16-in. boiler steel to hug the delivery end of the strainer between the twin outlets, and to extend outward far enough to provide space for an extended eye-bolt pin to replace the one broken out of the casting.

When thus formed to fit closely to the casting contour, a ⅞-in. hole was drilled as closely as possible in line with the old holes in the ears, and then reamed to take the 1-in. pin as a driving fit. A similar plate was formed for the other side, and these two connected by the pins so as to reinforce them close to the point where they took the strain from the eye-bolts.



Strainer Casting Strengthened by Yokes.

The centrifugal was again on the line in 51 minutes, including time required for reaming the new pin holes. Nor was it necessary to dismantle a single connection, nor to attempt any welding inside the gas-filled pump station. The entire cost of the vastly superior repair, including the steel for the two C-shaped yokes, was less than one-fourth that estimated for rebuilding the casting and the necessary machine work to make it again serviceable.

Bureau of Shipping Gives Views on Welded Vessels

By FRED J. MAEURER
Air Reduction Sales Co.

It should be a matter of considerable interest to welding groups to learn that the American Bureau of Shipping, which is a marine survey organization comparable to Lloyds, is favorable to the use of the modern welding processes in the construction of ships, barges, lighters, tankers, tenders, etc. Their survey engineers leave no doubt of their attitude toward welding by saying that they are doing everything possible, within their province, to encourage welded construction.

They cite the fact that while up to 1927 American Bureau of Shipping rules governing welded ships put them under an experimental classification, the Bureau removed the experimental classification clause and put welded vessels on a straight or regular classification in 1927. At present about half the vessels being surveyed and classed are of welded construction. Practically all tankers 260 ft. in length or less are being completely welded in essential detail.

During the period 1928 to 1934 the Bureau classed 44 welded vessels, having a gross tonnage of 27,000 tons, an average of about 600 gross tons per vessel, and since 1934 the total has increased to 137 vessels, having a total of 87,000 gross tons, and an average of 630 tons per vessel.

The Bureau engineers state that it is definitely proved that welding effects a weight saving of 16% compared with riveted construction on vessels of, say, 13,000-ton dead-weight capacity, with no reduction in the standards set up for structural strength in vessels. They have found little or no reduction of cost resulting from welding, however. While the welding cost amidship is less than with riveting, the extra cost of welding at the bow and stern wipes out any marked advantage.

Marine insurance companies make no distinction in insurance rates for welded or riveted hulls, but accident or collision insurance rates are lower on welded vessels because repairs can be much more economically carried on in a welded structure than in a riveted one. This is by reason of the fact that patches can be welded in after cutting away the damaged plates and preparing the edges for welding, whereas with riveted construction whole new plates must be laid out, drilled and reamed for rivet holes, and then riveted in place. The preparatory costs are much more complicated and costly than for welding.

The foregoing also holds good for a dented hull of welded construction. The plate affected can be heated and hammered out to the required shape, but if riveted, new plates must be inserted because any attempt to heat the plates and to hammer them out would loosen the rivets and necessitate their removal and replacement.

From the foregoing and the promotional efforts of the Bureau's engineers by way of publicity articles, there seems to be only one deduction, and that is welded-ship construction has definitely passed the experimental stage, and is now being encouraged by regulatory bodies, marine insurance companies and marine survey engineers.

Men in positions of authority who discourage their companies from using welding in the construction of barges and other transport vessels would seem to be definitely out of step with marine progress.

Western Metal Exposition to Be Held Next March

The Western Metal Congress and Exposition will be held in the Pan-Pacific Auditorium in Los Angeles, Calif., on March 21-25, 1938, under the auspices of the American Society for Metals. This will be the third event of this nature to be held on the Pacific Coast. The first was in Los Angeles in 1929, and the second in San Francisco in 1931, both of which were outstandingly successful.

Twelve national societies and associations having branches and sections in the West are arranging to participate in the technical program, the central theme of which will be, "Metals in Industry."

The Pan-Pacific Auditorium, where the congress will be held, is a new exposition hall, containing over 100,000 sq. ft., all on one level. Floor plans will be available about June 15 from W. H. Eisenman, secretary, American Society for Metals, 7016 Euclid Ave., Cleveland, O.

News of Welded Pipelines

The H. C. Price Co., Bartlesville, Okla., announces the receipt of the following contracts for arc welding pipelines: From T. R. Jones, Inc., and E. H. Reeder Construction Co., 24-in. loops in Kansas, Missouri and Illinois, for Panhandle Eastern. From Kelly Dempsey Co., 98 miles of 6-in. line in Iowa for the Great Lakes Pipe Line Co. From Osage Construction Co., 37 miles of 8-in. line in Kansas for the Continental Oil Co. From Williams Brothers, 27 miles of 6-in. line in Kansas for the Standish Pipe Line Co., to be welded by the stove-pipe method. From B & M Construction Corp., 67 miles of 6-in. line in Kansas for the Standish Pipe Line Co., to be welded by the stove-pipe method. From Ford, Bacon & Davis, Inc., 60 miles of 12-in. line from Philadelphia to Reading, Pa., for the Keystone Pipe Line Co. From Bechtel Kaiser, Inc., 21 miles of 10-in. line in Wyoming, for the Mountain Fuel Supply Co.

A contract for 20 miles of 10-in. and 18-in. gas line has been awarded the White Deer Pipe Line Construction Co. by the Oklahoma Natural Gas Co., running from Crescent to Enid, Okla., according to a report from The Linde Air Products Co., New York, N. Y. The line will be oxyacetylene welded.

Sixty miles of 8-in. welded pipe line will be laid in the near future by the Humble (Texas) Pipe Line Co. The line will extend from the East Texas field to Rodessa, and will transport natural gasoline.

The Trans-Pecos Pipe Line Co. will start work at once on a 33-mile welded oil pipe line, to extend from Majamar, southwest New Mexico, to Lynch, Texas.

Meetings of Interest to the Welding Field

Buffalo

"Simplicity of Stress Distribution in Arc-Welded Joints" was discussed by E. W. P. Smith, of The Lincoln Electric Co., Cleveland, O., at one of the sessions of the spring engineering conference of the Association of Iron and Steel Engineers held at Buffalo on April 28 and 29.

* * *

Chicago

"New Developments in Welding" is the subject of the meeting of the Chicago Section, American Welding Society, to be held in Mission Hall, Armour Institute of Technology, at 7:30 p. m. on Friday, May 21. "Multi-Layer Oxyacetylene Pipe Welding" is the subject of a talk to be given by Arthur N. Kugler, mechanical engineer, Applied Engineering Department, Air Reduction Sales Co., New York City. "Welded Machine Designs" will be discussed by T. C. Foekler, of the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa. Also, H. C. Boardman, of the Chicago Bridge & Iron Co., will read an English translation of a German paper describing the new Krupp process of welding with a special electrode to produce an austenitic-steel deposit having a Young's modulus value that is considerably lower than steel, thus eliminating high locked-up stresses in the weld without the necessity for subsequent stress-relieving. The meeting will be preceded with a dinner at 6:15, followed by a motion picture of a special nature.

A. M. Candy, of the Hollup Corp., gave a lecture on welding at the noonday luncheon of the Chicago Engineers' Club on April 27.

On the evening of May 10, during the annual "open house" held by Armour Institute of Technology, demonstrations of pipe cutting and beveling and of cutting with various types of machine torches, were given by the Air Reduction Sales Co., and a thermit-welding demonstration was given by the Metal & Thermit Corp. The Air Reduction Sales Co. also gave liquid-air and "Metalayer" demonstrations on the night of May 14 before the student body and faculty of the Morgan Park Junior College in Chicago.

* * *

Kansas City

"Field Welded Tanks" was the subject of a talk by Harry C. Boardman, director of research, Chicago Bridge & Iron Co., of Chicago, at the April 26 meeting of the Kansas City Section, American Welding Society.

* * *

Los Angeles

"Cathodic Protection and Corrosion of Pipelines," was the subject of a talk at the April 15th meeting of the Los Angeles Section of the American Welding Society. The speaker was Dr. Gordon N. Scott, Pipeline Technologist and formerly American Petroleum Institute Associate at the National Bureau of Standards, in Washington, D. C. A sound motion picture, "The Manufacture of Alloy Steels," was presented through the courtesy of the Bethlehem Steel Co., represented by George Stetter, metallurgist of the company's Los Angeles plant. Preceding adjournment, a review of the current issue of the society's organ, *The Welding Journal,* was conducted by J. C. Blake, past chairman of the Section.

* * *

New York City

Motion pictures of flame stack-cutting, and a 2-reel sound picture relating to the manufacture of steel from the ore to the finished product, featured the annual meeting of the New York Section, American Welding Society, held on May 11. Refreshments were served at the conclusion of an enjoyable session. C. W. Bryan, Jr., retiring chairman, presided.

* * *

San Francisco

Lt. Commander W. McL. Hague, of the U. S. Navy, spoke on "Welding in Ship Construction" at the meeting of the San Francisco Section of the American Welding Society held on April 30. This was followed by a talk on "Strain Measurements in Welds" by H. A. Storrs, chief inspector, East Bay Municipal Utility District. K. V. King, recently returned from an extended tour of the East, concluded the program with a review of conversations which he had with some of the leading members of the Society in the East, also giving a resume of recent pertinent articles on welding and cutting which have appeared in the Society's Journal and other publications.

Coming Events

May 24-27. Atlantic City, N. J., Auditorium. Annual Meeting of National Association of Master Plumbers.

May 31-June 4. Cleveland, O., Hotel Hollenden. National Convention of Building Officials' Conference of America. Business and technical sessions and exhibits. For further information write Building Officials' Conference of America, 505 City Hall, Cleveland, O.

June 28-July 2. New York City, The Waldorf-Astoria. Forfieth Annual Meeting of American Society for Testing Materials, and exhibit of testing apparatus and related equipment. For information write C. L. Warwick, 260 S. Broad St., Philadelphia, Pa.

Aug. 10-15. Mt. Pleasant, Mich. Oil and Gas Exposition, with exhibits and demonstrations.

Oct. 18-22. Atlantic City, N. J., Municipal Auditorium. National Metal Congress and Exposition. Also Annual Meeting of the American Welding Society, American Society for Metals, Wire Association, and other organizations. For information write W. H. Eisenman, 7016 Euclid Ave., Cleveland, O.

Oct. 27-29. White Sulphur Springs, W. Va., Greenbrier Hotel. Annual Convention of American Institute of Steel Construction. For information write V. G. Iden, Secretary, 200 Madison Ave., New York, N. Y.

Get "H. O. T." on Welding

By H. O. T. RIDLON

Do I Qualify?

This gent, Nick Rodder, that writes a swell line of chatter in the "ads" of International Nickel Co., sure knows his stuff, gets around the country and meets the right people. I sort of feel that perhaps I don't meet the right people, because I do get around. I've never been made a Kentucky Colonel as Nick was, but of course I guess one has to go through the right "ceremonies" to become a Kentucky Colonel.

But, speaking of ceremonies, I gave up drinking for Lent—not that one would consider me a drinker. When Lent started I had an even dozen bottles of "likker" in my cellar. My ever helpful and good wife insisted I empty the contents of each and every bottle down the sink, or else—so I said I would and proceeded with the extremely unpleasant task. After a little thought and many tears. I withdrew the cork of the first bottle and poured the contents down the sink with the exception of one glass which I drank. Then came the second bottle and out came the cork and I did likewise with the exception of one glass, or two, which I drank. I then withdrew the cork from the third bottle and emptied the "likker" down the glass, which I drank. I pulled the bottle from the cork of the next and drank one sink of it and threw the rest down the glass. I pulled the sink out of the next glass and poured the cork down the bottle and drank the glass. Then I corked the sink with the glass, bottled the trays and drank the pour. And so on until everything was emptied, or thought it must be. I steadied the house with one hand, and counted the bottles, glasses, corks and sinks with the other. It seems that this came to exactly twenty-nine. To be sure, I counted them again and when they came by I had seventy-four and as the houses came by I counted them again and finally had all the houses and bottles and corks and sinks counted with the exception of one bo#ttle & 1 hO*use which I? drANK*?!!

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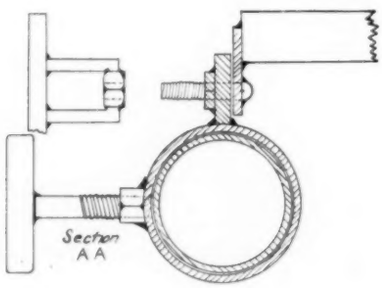
Keeping Things Where They Belong

It's sure all-fired important to keep everything where it belongs, but when it comes to a job welding shop much time is wasted in lining up broken parts to be welded and holding them there until you can get them tacked securely together. It would be almost impossible to figure the time and gas wasted in the average welding shop on this sort of thing. And after all, that's wasted time and money—ungained profits.

The drawings shown are of a universal jig for a welding table. Many improvements, extensions and betterments can be made on this idea. It all depends upon the equipment you have to make things with, and your ability to work it out. But as it is shown here it can be done in the smallest welding shop that has an oxyacetylene outfit, a hammer, and can get some scrap pieces of pipe and flat stock.

Fig. 1.



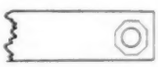


Fig. 4.

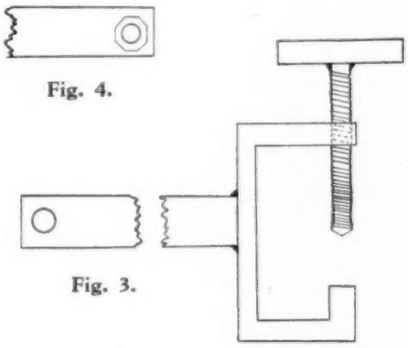


Fig. 3.

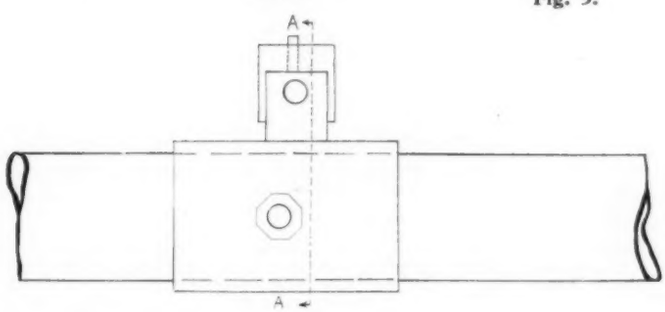


Fig. 2. (Left)

Fig. 1 shows the top of the welding table with only two of these clamps at the back of the table. Sometimes three clamps at the back are very helpful. And you will find that one or two of these clamps on each end of the table many times will be nothing short of a God-send. I've even had guys tell me that they'd like to have one or two on the front of the table also. But all those details depend upon the shop and the local conditions, as to the general type of repair jobs you get and how many pieces those jobs you get arrive in.

Figs. 2 and 3 show how nuts and bolts are used, welded onto the pipe, so that you get a universal-joint action.

As I say, many improvements can be made, but not all shops have taps and dies and drills and all that sort of thing. But a hole punched through with the cutting torch, nut welded over it, and piece of scrap round stock welded onto the end of the bolt, gives a very satisfactory result.

Fig. 4 attaches to Fig. 2 in the same manner, and a C-clamp is welded on the end of it. You can make or buy the C-clamp.

Of course if you have a machine shop along with your shop you can work out the same general idea; but instead of using some screw method to hold these various parts rigid, an eccentric clamping device is naturally much quicker and better. Wherever possible in jigs, I strongly suggest the eccentric clamp, because it is much faster both in fastening and unfastening.

• • •

Hot Sparks

The shortest space of time is that between the time the traffic light turns green and the time the lug behind you blows his horn.

Just stop and think, son, what kind of a collection of mourners you are training for your final event!

Please, son, don't ever be a five hundred dollar millionaire.

• • •

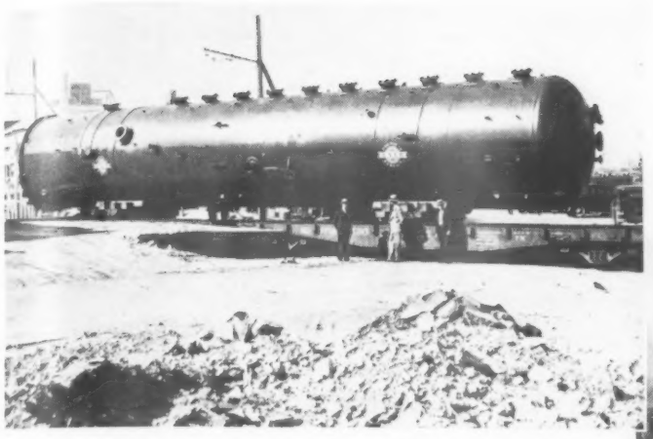
The thought for the month: Can thoughts be silent when they find an echo in another's mind?

• • •

So long! I'll be seeing you again.

The Ambassador of Hard-Surfacing.

WELDING NEWS IN PICTURES



• Large welded tower, oven stress-relieved, built by Black, Sivalls & Bryson, Inc., Oklahoma City, Okla. The tower is 12 ft. in diameter by 74 ft. long. A special engine and caboose were used to transport this unit by rail because the clearance in some of the bridges was less than 2 in.

• Welding the 9-in. guard-rails, placed on top of curb-rails of the two upper roadways of Manhattan Bridge as a measure of vehicle protection. Four rows, extending between New York City and Brooklyn, totaling more than 25,000 ft., were tack-welded into place by Scott Welding Service, L. I. City, N. Y.

• (Right) All-welded steel house with garage incorporated—the first of its kind to be built completely inside a factory. Designed and built by R. G. Le Tourneau, Inc., Peoria, Ill. Moved to site in one complete unit. (Photo courtesy of James F. Lincoln Arc Welding Foundation.)

• Using prefabricated panels and arc welding, this attractive playhouse was erected at little cost for a safe "get them out of the house" playroom. It is equipped with stove and includes double-deck bunk. (Photo courtesy of Hobart Brothers Co.)

• New broadcasting tower for KFWB of Hollywod, Calif., made by International Derrick & Equipment Co., of Torrance, Calif. It is 450 ft. high, constructed in 20-ft. sections and shop fabricated by arc welding. (Photo courtesy of Metal & Thermit Corp.)

What's New in Equipment and Supplies

Rod for Low-Temperature Cast-Iron Welding

A new welding rod for welding and brazing gray cast iron, malleable iron, chilled castings, and other castings, at a cherry-red temperature, has been announced by the Nu-Welding Processing Corp., 110 S. Hanover Street, Baltimore, Md. This rod, known as the "Cosiro" coated silicon welding rod, is available in diameters of 3/16, ¼ and 5/16 in. No extra flux is required. The weld deposit and surrounding metal is said to be soft and easily machineable, with no hard spots or air bubbles present.

Portable X-Ray Unit for Field Testing

A portable x-ray unit mounted on a trailer chassis is being used by the St. John X-Ray Service, Inc., 30-20 Thomson Avenue, Long Island City, N. Y., for field inspection of welded structures and piping. This unit is powerful enough to penetrate 3 in. of steel in a

X-Ray Unit Mounted on Trailer Chassis.

one-minute exposure. It has a ray- and shock-proof tube of the air-insulated and water-cooled type, with 30 ft. of cables, thus making it possible to bring the machine to the work. The cover can be utilized as a field darkroom. The unit weighs about 3,000 lb.

A.C. Welders With Special Current and Voltage Control

A new line of a.c. portable arc welders has been announced by the Pier Equipment Manufacturing Co., Welding Equipment Division, 556 Cross Street, Benton Harbor, Mich. These welders are of the transformer type, with reactance, and employ a circuit that is said to provide a stable, non-blasting arc without splatter loss. They can be used on a wide range of work from 22-gauge sheet metal to heavy castings.

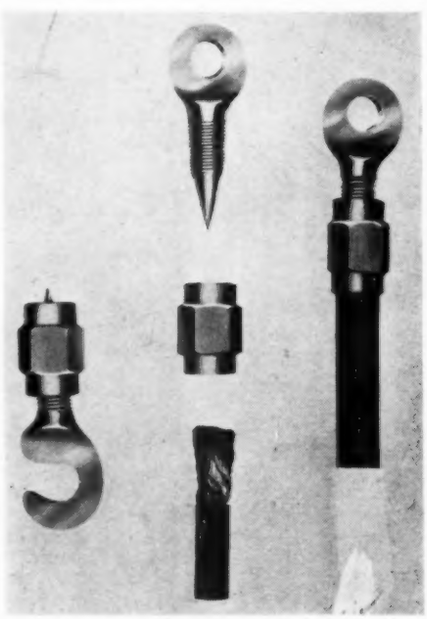
An efficiency of more than 90% at full load is claimed, as well as good penetration. A special circuit and control, known as the "Ace Synchro Control," is said to provide a control of voltage and current comparable to that used with motor-generator d.c. arc welders.

"Ace" Transformer-Type Welder.

These units are made in sizes from 15 up to 250 amperes, for use with 1/16-in. to ¼-in. welding electrodes.

New Line of Cable Connections

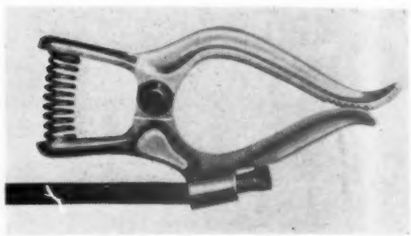
A complete new line of cable connections, including ground clamps, electrode holders and mechanical cable lugs and connectors, has been put on the market by the Tweco Products Co., 829 S. Madison, Wichita, Kan.



"Tweco" Mechanical Cable Lugs.

The "Redhead" ground clamp, which is illustrated, makes a quick, positive ground that is capable of carrying high currents, thereby lessening the need for making machine adjustments, and eliminating cable heating. The ground connection is easily moved to eliminate arc blow, and in many cases can be kept close to the arc, in view of the quickness with which the clamp can be detached and re-attached.

The view of the mechanical cable lugs illustrates the Tweco principle of a tapered screw terminal wedging into a hollow corrugated body, thereby giving a positive connection. In case of cable breakage, field installation is quickly made. These lugs are made of a high-copper alloy, and the hexagon shape of the body facilitates holding the lug while installing. The open-type lugs shown permit easy installation on machine



"Redhead" Ground Clamp.

terminals without completely removing the wing nuts, thus facilitating change-over for reverse polarity.

New Electrode for Welding High-Tensile Steels

A heavily coated shielded-arc electrode, known as Champion Blue Devil-85, has been developed by The Champion Rivet Co., for welding the low-alloy and higher-carbon high-tensile steels. It can be used in the flat, vertical and overhead positions, and is said to produce welded joints having all the individual characteristics inherent in such steels as Cor-Ten, Man-Ten, Sil-Ten, Cromansil, Hi-Steel, 79-90, Yoloy, R. D. S., and HT 50; also carbon-molybdenum steel, silicon-killed plate (A. S. T. M. 149 and 150) and the low-nickel-content steels. Complete test data, welding procedure, and other technical information are available from The Champion Rivet Co., Cleveland, O.

Automotive Repair Outfit Announced by Rego

A complete welding and cutting outfit for automotive work has been announced by The Bastian-Blessing Co., 278 E. Ontario Street, Chicago, Ill. This outfit consists of a standard Rego GX torch with five tips and cutting attachment.

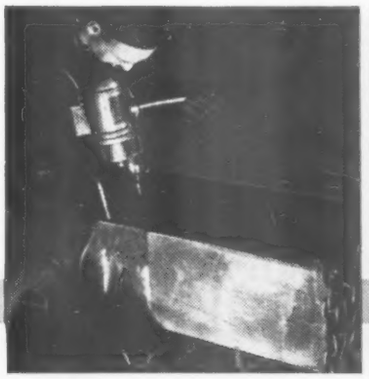
ANOTHER

"Impossible" Job Made *Possible*

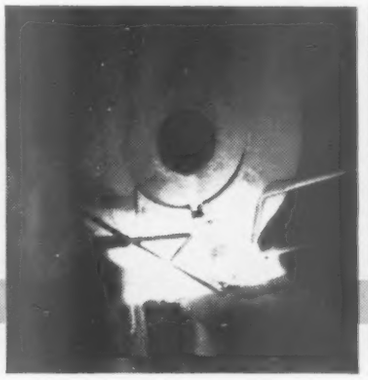
WITH TOBIN BRONZE!

Here's a particularly interesting repair job recently completed by the J. L. White Welding Co. of Waterbury, Conn. A severe fracture occurred in the huge 5½ ton frame of this heavy duty Roll Stand. Time and money were important. It had to be repaired. Yet the tremendous size of this casting—plus the great depth of the fracture—made ordinary cast-iron welding impossible... TOBIN BRONZE was rushed to the rescue! And this difficult job was completed in a most satisfactory manner!

HERE'S HOW IT WAS DONE

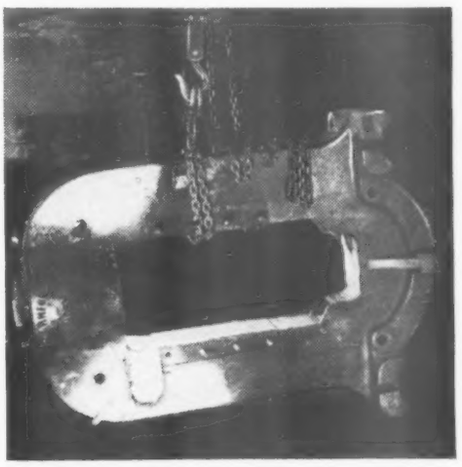


1 VEE-ING OUT with hand-drill



2 WELDING with two torches

3 CLOSE-UP of Tobin Bronze Weld



4 BACK IN SHAPE...Thanks to Tobin Bronze!

ORDINARY WELDING WAS IMPOSSIBLE!... For a casting of this size and shape would have required furnace pre-heating. The casting would have absorbed so much heat that working on it would have become practically impossible.

TOBIN BRONZE ELIMINATED FURNACE PRE-HEATING... The fracture area was first veed out with a drill. Then *locally* pre-heated for several hours with two gasoline torches... And, with Tobin Bronze, the damage was quickly repaired.

Time after time Tobin Bronze has proved itself the most satisfactory welding rod for difficult jobs on cast and malleable iron... This time-tried Anaconda product makes highly satisfactory repairs at low cost... Look for the trademark: "Tobin Bronze Reg. U. S. Pat. Off." And be sure you're getting genuine Tobin Bronze! 27359

ANACONDA
from mine to consumer

Anaconda Welding Rods

THE AMERICAN BRASS COMPANY, General Offices: WATERBURY, CONNECTICUT

Offices and Agencies in Principal Cities • In Canada: ANACONDA AMERICAN BRASS LTD., New Toronto, Ont.

Complete Automotive Repair Outfit.

oxygen and acetylene regulators, flux, two lengths of hose, spectacles, spark-lighter, gloves, and other necessary accessories. An instruction chart is included. This new outfit is described in a folder recently issued by the company.

New One-Piece Welding Helmet

A new welding helmet, offered by Willson Products, Inc., Reading, Pa., is formed of one-piece black vulcanized fibre, cut deeply to offer side protection to a point well back of the ears. The new helmet is said to have great ruggedness to withstand hard shop use. The usual riveted, lapped-over seams or joints are eliminated; a smooth, rounded interior promotes air circulation and results in a well ventilated, cool, comfortable helmet. Willson-Weld glass of 2x4¼-in. size is standard in the new helmets. The Willson company is making several different styles of helmets in one-piece construction. The new line also includes one-piece handshields.

New "Willson" Helmet.

Ryerson Announces New Stainless-Steel Electrode

A new reverse-polarity electrode having an analysis of 18% chromium, 8% nickel, and carbon 0.07% maximum, is announced by Joseph T. Ryerson & Son, Inc., 16th and Rockwell Streets, Chicago, Ill.

This electrode is intended for the welding of all stainless steels in the 18-8 group, including those containing titanium. The heavy coating, which provides a complete shield for the arc, is applied by the extruding process. The coating is carbon free, thus eliminating the possibility of carbon pick-up in the weld deposit. The chemical, physical and corrosion-resistant properties of the weld deposit are said to be similar to the parent metal when applied to 18-8 steels.

This electrode produces an unusually quiet, smooth-flowing arc, with little or no splatter loss. The protective gas generated by the coating is said to be non-injurious to the welder. A brittle, friable slag protects the weld metal while cooling and can be easily and completely removed with a wire brush. An outstanding feature claimed for this electrode is that no difficulty is experienced in restriking the arc when the arc is broken numerous times with the same electrode, such as when tacking up a job.

This welding rod may be used in the flat, vertical or overhead positions. It is also being used for building up worn manganese-steel rail crossovers and manganese castings as well as joining broken manganese parts. A bulletin describing this new electrode and other stainless-steel rods is available from Ryerson offices.

Trade Literature

Pipe welding by the oxyacetylene process is covered extensively in a booklet issued by The Bastian-Blessing Co., 278 E. Ontario Street, Chicago, Ill. Subjects dealt with include equipment, preparation of pipe, providing for expansion and alignment, templates for cutting pipe, cutting branches without templates, fabrication of headers, special pipe fittings for welding, designing a welded layout, qualifying the welding operator, and pipe-welding costs.

"The Welding of Enduro Stainless Steel" is the title of a new 20-page booklet issued by the Republic Steel Corp., Cleveland, O., which describes procedures for arc, gas, seam, spot, projection and atomic-hydrogen welding, as well as brazing and soldering. By means of a table, the properties of 13 varieties of Enduro stainless steel are contrasted with similar properties of a carbon steel, SAE 1020.

"Modernized Metal-Forming Machinery" is the title of a folder issued by the National Electrical Manufacturers Association, Electric Welding Section, Frick Building, Pittsburgh, Pa. It describes how welding makes possible better machines by employing designs that make for strength, stiffness, versatility in design, pleasing appearance, etc.

"True Colors, Quick Color Changes—with Textile Equipment of Enduro Stainless Steel" is the title of a new 12-page booklet published by the Republic Steel Corp., Cleveland, O., which sets forth the properties and fabrication of stainless steel. Illustrations of yarn samples in four colors show the advantages of Enduro stainless steel in retaining true colors of dyed yarn.

"Standardizes Quality in the Heat-Treatment of Metals" is the title of a new folder issued by The Brown Instrument Co., Wayne and Roberts Avenues, Philadelphia, Pa., describing the use of the Brown Analy-Graph for recording minute changes in the chemical composition of furnace atmospheres.

"The Arc Welding of Stainless Steels" is the subject of a bulletin issued by the Arcos Corp., 401 N. Broad Street, Philadelphia, Pa., which describes the welding and heat-treatment of various chromium-nickel and straight-chromium steels.

"Machining Monel, Nickel and Inconel" is the title of bulletin T-12, issued by The International Nickel Co., 67 Wall Street, New York, N. Y. This pamphlet deals with cold cutting, turning, boring, drilling, reaming, tapping, threading, planing, milling and precision grinding.

"Cost Factors in Fabricating Shop Practice" is the subject of Plate 60 of "Studies in Structural Arc Welding," issued by The Lincoln Electric Co., Cleveland, O. Examples of cost variation are shown in the case of a plate girder, a seat angle and a column and column base.

"Flexarc" engine-driven single-operator welders, rated at 200, 300 and 400 amperes, are described in a recent pub-

lication issued by the Westinghouse Electric & Manufacturing Co., Dept. 5-N, East Pittsburgh, Pa. Performance curves and fuel-consumption curves are included.

"The Arc-Welding of Tomorrow" is the title of bulletin W-10, dealing with "Smoothare" welders, issued by the Harnischfeger Corp., 4513 W. National Avenue, Milwaukee, Wis. It discusses single current control and other features of design. A cutaway view tells the story of "Smoothare" design.

"National" shape-cutting machines are illustrated and described in a folder issued by the National Cylinder Gas Co., 205 W. Wacker Drive, Chicago, Ill. A wide variety of flame-cut shapes are shown.

A low-temperature brazing alloy known as "Alloy No. 1300" is described in a folder issued by the Alloy Specialties Co., Box No. 16, Swissvale, Pa.

The operation of the safety reducing value or oxyacetylene regulator is explained and shown by simple sketches in a folder issued by the Modern Engineering Co., 3407 Pine Blvd., St. Louis, Mo.

"American" seamless flexible tubing is described in bulletin SS-3, published by The American Brass Co., American Metal Hose Branch, Waterbury, Conn., in which a number of applications are shown.

A combustible-gas indicator is described, and some of its uses explained, in a folder issued by the Mine Safety Appliances Co., at Braddock, Thomas and Meade Streets, Pittsburgh, Pa.

"Tips on Cable Uses" is the title of a folder issued by the General Electric Co., Schenectady, N. Y., showing more than 20 different kinds of cable for arc welding and other purposes.

Commercial News

Joins Bastian-Blessing as Eastern District Manager

R. Adam Johnstone has joined The Bastian-Blessing Co. as eastern district manager with headquarters at 635 Sixth Ave., New York, N. Y. Mr. Johnstone,

R. Adam Johnstone.

a graduate of the University of Missouri, has specialized in sales engineering work in the liquefied-petroleum-gas field in various sections of the United States.

The Craftsweld Equipment Corp. are celebrating their tenth year of incorporation by moving to more conveniently located quarters at 2727 Jackson Ave., Long Island City, N. Y. The new location, near Queensborough Bridge Plaza, possesses enlarged facilities for manufacturing, demonstrating and servicing. Charles Kandel, president, is receiving congratulations on his recent completion of 20 years of service to the welding industry.

H. O. Hartdegen, sales engineer with the Driver-Harris Co., has taken charge of the company's territory comprising northern New York state and eastern Pennsylvania, and will also handle some accounts in New Jersey. This territory was formerly assigned to J. B. Shelby, who has been advanced to the management of the company's foundry division, where he will act as co-manager with J. Sammon.

The Huey & Philp Hardware Co. have been appointed distributors of Enduro stainless steel by the Republic Steel Corp. Stocks will be carried in warehouses at 1900 Griffin St., Dallas, Texas, and at 2310 Main St., Houston. Another new distributor is the Star Steel Supply Co., 7522 Oakland St., Detroit, Mich.

The H. C. Price Co., a co-partnership, has been formed, and the electric-welding business of H. C. Price, Inc., has been transferred to this partnership. The general offices will remain at Bartlesville, Okla., with branch offices at Los Angeles and San Francisco.

The Welding Equipment & Supply Co., 2720 E. Grand Blvd., Detroit, Mich., have been appointed exclusive distributors of Torchweld welding and cutting equipment in Detroit and surrounding territory, and will carry a complete line in stock.

The Electro Cover Glass Co. have moved their offices from McCance Block, Pittsburgh, to new quarters at Sharpsburg Branch, Pennsylvania. Manufacturing and sales headquarters will be maintained at the latter address.

RYERSON *a dependable source for* **WELDING ROD**

Ryerson Engineers have developed a series of rods that are outstanding for Quality production. More than twenty types including both electric and gas rods are carried in stock. Whether you need a shielded arc type for production work or a stainless steel rod you can be sure of immediate shipment.

ELECTRODES

Ryerson Shielded Arc Type No. 215
Ryerson Shielded Arc Type No. 216
Ryerson Shielded Arc Type No. 217
Ryerson Green Processed No. 18
Ryerson Green Processed No. 6
Ryerson Bare Mild Steel
Ryerson Brown Processed
Ryerson White Flux Coated
Ryerson High Carbon White Flux Coated
Ryerson Blué Flux Coated
Ryerson 3½% Nickel Steel Flux Coated
Ryerson High Manganese Steel
Ryerson Hard Surfacing
Ryerson Allegheny Stainless Flux Coated
Ryerson Allegheny Stainless No. 44

GAS RODS

Ryerson Copper Coated No. 206
Ryerson Copper Coated No. 210
Ryerson Cast Iron
Ryerson 3½% Nickel Steel
Ryerson Tobin Bronze
Ryerson High Carbon Bare No. 2110
Ryerson Allegheny Stainless Bare
Ryerson Hard Filler

Write for descriptive bulletin

JOSEPH T. RYERSON & SON, INC.

Chicago. Milwaukee. St. Louis. Detroit. Cleveland. Cincinnati. Buffalo. Boston. Philadelphia. Jersey City

R. B. Bradley, H. K. De Vries and J. C. Hohnhart have joined the Murex Electrode Division of the sales staff of the Metal & Thermit Corp. Mr. Bradley will be located in Chicago, Mr. De Vries in Cincinnati, and Mr. Hohnhart in Detroit.

The summer meeting of the Compressed Gas Manufacturers' Association will be held at the Seaview Golf Club, Absecon, N. J., on Thursday and Friday, June 24 and 25.

The Whitmore Oxygen Co., 430 E. South Temple St., Salt Lake City, Utah, have been appointed distributors for the welding electrodes, applicator and wedge bars, and hard-facing rods manufactured by the Stulz-Sickles Co., Newark, N. J.

A. W. Benn has been appointed sales manager in the new St. Louis territory of the Harnischfeger Corp., Milwaukee. Mr. Benn until recently was connected with the Keasbey-Mattison Co.

The Johnson Welding Equipment Co., Chicago, have moved from their former location on Nelson Ave. to their modern store at 729 S. Western Ave.

Notes From the Field

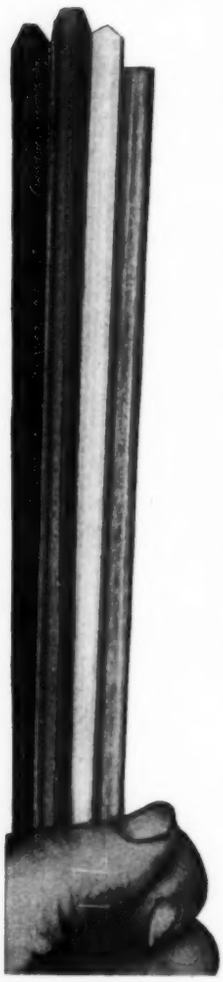
Ewald Speckhals, proprietor of the Brake Service Co., 1511 S. Twelfth Blvd., St. Louis, Mo., has begun construction of a work bench and an auto rack for use in his shop. This additional equipment, of which he claims to be in considerable need, will be of all-welded steel construction. Speckhals, known locally as "Specks," says that not only will welding of the equipment be more economical than bolting or riveting, but the former process will consume less than one-fifth the time required to drill holes and insert bolts or rivets. Moreover, the welded job is more substantial, safer and neater. Most of the welding done by the Brake Service Co. is in connection with repairing of auto and truck frames and with installing and repairing of brakes.

The American Bridge Co., of Pittsburgh, Pa., have been formally notified by the Bureau of Reclamation, Department of the Interior, Washington, D. C., that they have been awarded a contract for the construction of regulating gates for the spillways of three dams. This contract, which involves a large amount of welding, includes the construction of 10 steel gates, each 50 ft. high, 50 ft. wide and 6 ft. thick, in which 2,700 tons of steel plates and shapes are required. The work will be accomplished at the Ambridge, Pa., plant in the Pittsburgh district. These gates will be installed in the Bartlett and Mormon Flat dams, in the Salt River project in Arizona, and in the Parker Dam at Earp, Calif. The gates will be electrically operated.

An oxyacetylene cutting torch was used to release Wm. Hay, a workman with the Hecker Flour Co., of New York City, when he had his right foot pinned by the spoke of a huge flywheel and was held dangling in the air for two hours before being found. Hay was trying to kick the wheel off dead center, when he slipped and his right foot became pinned in the wheel. Because of the grease on the wheel, the burner carried with him a fire extinguisher when he cut off a 2-ft. spoke to release Hay. The grease-coated wheel caught fire twice, but both men were protected by an asbestos covering.

Recently a locomotive crane, used for loading ties at the East St. Louis, Ill., plant of the T. J. Moss Tie Co., was incapacitated by a fracture in the 3½-in-

HAVE YOU TRIED THESE FOUR NEW RODS?



HERE are four new electrodes with which you will want to become acquainted. If you use arc welding as a manufacturing or plant maintenance process, you are invited to write, giving a brief description of the character of your work, and we shall be glad to recommend the most suitable electrode and send you samples for testing.

***Arc-Craft* "55"—A high-speed gas-shielded, all-position electrode with light, easily removed slag. For use with reverse polarity. Suitable for use with AC as well as DC welders. Excellent general purpose electrode.**

***Tank-Craft* "50"—Features high ductility and low spatter loss. A gas-shielded, all-position electrode for use with reverse polarity. Produces light slag easily removed.**

***Fillet-Craft* "60"—A heavy-slag-shielded, straight polarity electrode for position and semi-position welding on mild steel. Gives true concave fillets free from undercutting. Suitable for use with AC as well as DC machines.**

***Arc-Craft* "70" — A fast, light-slag-shielded straight polarity electrode for jobs that do not "fit up" well. For general purpose, all-position welding.**

Adams also offers a complete line of equipment including Vertical DC and AC Welders, Engine-Driven Welders, Automatic Welding Heads and Wire, and electrodes for stainless steel, manganese steel and aluminum.

J. D. ADAMS COMPANY
Welding Division
INDIANAPOLIS : : INDIANA

ADAMS **ARC WELDING ELECTRODES**

thick cast-iron bed that supported the steam hoisting engine. The job of making the repair fell to the Simon-De Vine Welding Co., 3206 Easton Ave., St. Louis, Mo., whose president, W. A. Eskridge, inspected the break and found that it encircled the journal and penetrated the eight brackets reinforcing the bed. The brackets, likewise of cast iron, were 16 in. wide by 2½ in. thick. Eskridge says the job was too big to heat, and the only solution, in his opinion, was to braze it. Three men were employed eight hours in making the repair and approximately 185 lb. of bronze rod was used.

Considerable welding is being done to vessels in the Pittsburgh harbor in preparation for a mammoth freight movement during the summer months. The steamer *Champion Coal,* flagship of the Pittsburgh Coal Co., is undergoing general repairs at the Elizabeth, Pa., marine ways of the company. Work has been started at the Neville Island marine ways of the Dravo Corp., Pittsburgh, Pa., to convert a steam whirler derrick boat for dragline purposes, to be used in river dredging. Repairs are also being made on the same marine ways to one of the 195-ft. tank barges of the Campbell Transportation Line, of Pittsburgh.

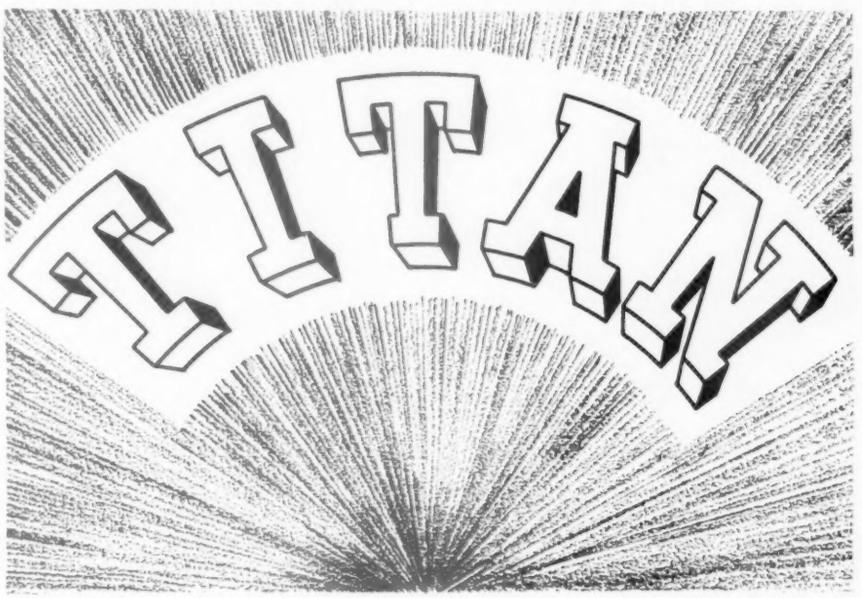
The U. S. Army Engineers office in Pittsburgh will open bids late in May for the construction and delivery of two hoists with a capacity of 20 tons each to be installed at the Emsworth dam, on the Ohio River, in the Pittsburgh harbor. These hoists, which will involve considerable welding, will be of the two-hook monorail type with a minimum lift of 30 ft. According to specifications, they are to have a full hoisting speed of 10 ft. per minute and a traveling speed of 150 ft. per minute, and will be equipped with 20-hp. motors. Delivery is to be made within 150 days to the U. S. Depot at Lock No. 2 on the Ohio River.

The Woerner Wire Works, 13th and Evans Sts., Omaha, Nebr., are using welding in the manufacture of wire fences for lawns, cemeteries and parks. Just now there is a contract on hand for seed-packet display cases for the large wholesale seed houses over the country. Another all-welded job is the manufacture of wire racks, each capable of holding 750 lb. of meat. These racks are rented by the meat men in small towns to their patrons at a small cost. The butcher rents storage space for them and furnishes the refrigeration. These racks are made with 1½-in. angle iron for corner posts.

The huge cutter-head dredge *Rock Island,* built by the Dravo Corp., Pittsburgh, Pa., for the U. S. Engineers of the Rock Island district, was launched at noon, April 10, from the Neville Island shipyards of the company on the Ohio River. The launching marked the completion of the eighth mammoth digger built by the corporation for the U. S. Engineers for use in the improvement of rivers and for flood control. It is a sister boat of the *William A. Thompson,* launched last March and described on page 23 of the March issue of *The Welding Engineer.*

Removal of the American Iron-Steel Mfg. Co., 4920 Easton Ave., St. Louis, Mo., to 6185 Minerva Ave. on June 1 will mark the second expansion of this concern during the past year. Some months ago, finding themselves cramped, they took over a building in the rear of their Easton avenue quarters, thereby doubling the floor space. Upon removal to the new location, floor space will again be doubled. George Frankey, president, says additional machinery will be installed, making a modern welding and sheet-metal shop.

United Shipyards, Inc., New York City, recently received several large orders for all-welded floating equipment. These include two oil barges from the Socony-Vacuum Oil Co., of New York City, and one oil barge from the Pfeifer



TITAN DOUBLY-DEOXIDIZED BRONZE WELDING RODS* are widely used and preferred by experienced welders in ever-growing numbers. *Increased strength plus increased ductility* are secured through use of PENN BRONZE and other Titan Rods, due to the exclusive Double Deoxidation feature, found only in Titan alloys. Double Deoxidation is insurance against the formation of oxides that prevent the best welding.

*U. S. Patent No. 2,022,439.

(Trade Mark Registered)

Assure dense, strong welds by using Penn Bronze, and other Titan alloys. Samples of Penn Bronze, Titan Bronze, Titan Brazing Bronze and Titan Manganese Bronze alloys gladly forwarded on request. *Write today for descriptive literature.*

Titan Metal Manufacturing Co.

Bellefonte, Pennsylvania

Oil Transportation Co., also of New York City. The former are of the non-propelled type with an all-welded steel bulk, 177 ft. long, 36 ft. wide and 13 ft. 6 in. deep, while the latter barge will be 110 ft. long, 36 ft. wide and 11 ft. 6 in. deep, with a capacity of 274,000 gallons.

The Bureau of Lighthouses, Department of Commerce, Washington, D. C., will open bids shortly at Washington for the construction and delivery of one twin-screw steel lighthouse tender for use by the Fifteenth Lighthouse district at St. Louis. This boat is to be 103 ft. long, 24 ft. wide, 5 ft. deep, of 170 tons displacement, and is to be equipped with two engines of 150 hp. each, and two derricks. It will be named the *Goldenrod*, and will be used in Mississippi and Missouri River service.

U. S. Engineers in the Pittsburgh District will open bids shortly for the construction of a survey boat for service on rivers in the Pittsburgh harbor. It is to be equipped with a 6-cylinder gasoline engine and must develop 150 b. hp. The bottom and side planking are to be of Philippine mahogany, while all metal work is to be of corrosion-resisting metal. It will be 32 ft. long, 10.3 ft. wide and 2 ft. 3 in. deep. Delivery is to be made within 40 days.

A welder quitting work for the lunch hour, and for lack of a more convenient place to hang or lay his torch, thrust the tip into the open bung hole of a nearby empty barrel, according to a report from Detroit. Evidently the torch valves were leaking, for the barrel filled with gas. After lunch the welder returned, picked up his torch and lit it, swinging it around over the open bung hole of the barrel. The escaping gas ignited and an explosion followed, resulting in a fatality.

Fabrication of steel plates for a fleet of 25 all-welded steel standard coal barges for the Wheeling Steel Corp., Wheeling, W. Va., has progressed to such an extent the barges are now being assembled in the Neville Island yards of the Dravo Corp. in Pittsburgh. Delivery will be completed late in May. The Wheeling Steel Corp. recently asked for bids for the construction of a modern twin-screw towboat for service on the upper Ohio River including the Pittsburgh harbor.

New research methods in dynamic testing and x-ray investigations of welded bridges, by which comparisons can be made simultaneously between riveted and welded structures, were outlined in a special lecture given recently by Dr. Rudolf K. Bernhard, formerly chief engineer of bridges with the German State Railroads, and now with the Baldwin-Southwark Corp., before the faculty, alumni and students of the New York University College of Engineering.

The International Railweld Corp. have completed the arc welding of battered rail ends and the installation of 11,000 new oversize angle bars on 24 miles of the Missouri-Kansas-Texas Lines between Brookshire and Houston, Texas. Upwards of 250 joints, covering ¾ mile of track, were welded, ground and cross-cut in a single day. A similar rehabilitation project will be started on the "Katy" track between Muskogee and Vinita, Okla., it is reported.

On May 3, the Marietta Manufacturing Co., Point Pleasant, W. Va., launched a modern all-welded steel towboat for the Standard Oil Co. of Louisiana. The boat, of the sternwheel type, will be used on inland-waterway service. It is 190 ft. long, 42 ft. wide and 7.6 ft. deep. This boat, one of the largest and most powerful of its type, has been designed to be operated as the most economical towboat in the lower Mississippi River trade.

The Peter Jensen Welding Co., 23 18th St., New Albany, Ind., is on the road to business recovery for the first time since the devastating Ohio River flood submerged its shop under 15 ft. of

COLMONOY SWEAT-ON PASTE

Will bring in new customers and make better friends of old customers, and

IT WILL MAKE MONEY

For You and for Your Customers

COLMONOY SWEAT-ON forms a wear-resistant overlay on steel or cast iron, and it can't chip off because it becomes a part of the parent metal. After overlaying steel with COLMONOY SWEAT-ON, it can be formed, forged or heat treated, without in any way decreasing the efficiency of the wear resisting overlay.

Plow shares, cultivator teeth, parts of excavating equipment, and similar wearing surfaces may be hard faced with COLMONOY SWEAT-ON, and then heated up and forged down, if necessary or desirable.

And, COLMONOY SWEAT-ON costs less applied than other hard facing materials which are much less efficient.

COLMONOY SWEAT-ON is furnished in paste form in collapsible tin tubes or cans, or in dry powdered crystal form, for mixing with water glass (sodium silicate)—and in either form is easily applied with the oxy-acetylene torch, furnace heat or the carbon arc.

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water. Remodeling the shop has been the main consideration for the past few weeks. Several welding jobs on river coal barges have been undertaken recently, and production of welded articles as sidelines is soon to be undertaken.

Authority to certain firms to construct additional tank-car tanks by the fusion-welding process, for experimental service, has been granted by the Interstate Commerce Commission, these to include 50 tanks by the General American Transportation Corp. for the transportation of petroleum products, one tank by E. I. duPont de Nemours & Co. for transporting nitric acid, and four tanks by the Texas Chemical Co. for muriatic acid.

The Chicago Bridge & Iron Co., of Chicago, Ill., have received a contract for the fabrication and erection of three large spheres for the Humble Oil Co., Baytown, Texas. Two of these vessels, with a capacity of 12,500 barrels each, will be designed for an internal working pressure of 50 lb. per sq. in., and the third sphere, with a capacity of 5,000 barrels, will have a working pressure of 100 lb.

An all-welded aluminum tank, 8 ft. in diameter and 9 ft. deep, is being constructed by the Alpha Tank & Sheet Metal Mfg. Co., 3883 Delor St., St. Louis, Mo. The vessel, to be installed in a local brewery upon completion, will serve as a container for yeast in the process of fermentation. The sides of the vessel will be formed of a single sheet of aluminum, measuring 104x304 in.

A contract for the construction of a fleet of 8 steel coal barges has been awarded the Dravo Corp., of Pittsburgh, Pa., by the Semet-Solvay Co. of New York. These barges are of standard specifications and of all-welded construction. Four of them have already been delivered to Point Pleasant, W. Va., where they will be used in moving coal on the Kanawha River.

The Jones & Laughlin Steel Corp., of Pittsburgh, Pa., are doing considerable all-welded barge construction at the present time. Recently the company completed ten 132-ft. barges for its own service on the Ohio River and inland waterways, and the company now has under construction 25 all-welded coal barges for the Vesta Coal Co., Jones & Laughlin subsidiary.

L. B. Thomas, owner of the Economy Welding Co., 18th and Cuming Sts., Omaha, Nebr., recently completed some all-welded bridges for the Federal Government at Columbus, Nebr. Eight arc-welding units were used on these jobs. Eighteen of these bridges were spans over the inflow and outflow channels of the big reservoir of the Platte and Loup Rivers.

The George Bott Welding Co., 201 E. Fourth St., New Albany, Ind., is at work on farm machinery and motor trucks, the latter the property of the Denny Motor Co. Mr. Bott reports that his firm, like other welding concerns in this territory who suffered flood damage, is planning renovation of its shop.

Dale Prow, of the pioneer welding concern of Prow & Leffler, El Monte, Calif., has sold his interest in the business to his partner, S. P. Leffler, and moved to Murphy, Calif., where he will engage in mining. The concern will continue to be operated under the original name by Mr. Leffler and his efficient office manager (and wife), Nellie Leffler.

The U. S. Army Engineers office in Pittsburgh are taking bids on two cargo-type barges having general dimensions of 130x30 ft. by 7½ ft deep. Prices are being taken on welded as well as riveted construction. The bids are to be opened early in June. Approximately 275 tons of steel plates and shapes will be required to fabricate the order.

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Extra Flexible

WELDING CABLE

● **The ideal welding cable must be flexible, must stand abuse and be perfectly insulated.**

Okocord Welding Cable embodies these three attributes. It is extremely flexible, because the conductor is made of a great many fine copper wires. It withstands mechanical abuse because it is made with a jacket of tough, tire-tread type of 60% rubber. It has perfect insulation because it is insulated by The Okonite Company — an acknowledged leader in the insulation field since 1878.

For long trouble-free service, use Okocord Welding Cable.

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and

HAZARD INSULATED WIRE WORKS DIVISION

THE OKONITE-CALLENDER CABLE COMPANY, INC.

EXECUTIVE OFFICE: PASSAIC, N. J.

New York, Boston, Chicago, Detroit, Philadelphia, Pittsburgh, Washington, San Francisco, Los Angeles, Seattle, Dallas, Atlanta, Buffalo

Factories: Passaic, N. J., Wilkes-Barre, Pa., Paterson, N. J.

Under date of May 7, the Dravo Corp. launched at its Wilmington yards, in New Jersey, the first of an order of five all-welded steel lighter barges for the Pennsylvania Railroad. These carriers, the material for which was fabricated at the Neville Island shop of the Dravo Corp., are of the deck type, 80 ft. long, 30 ft. wide and 9 ft. deep.

An order for a light-weight, stainless-steel, stream-lined train, to be built by the "shot-weld" process, has been received by the Edward G. Budd Manufacturing Co., Philadelphia. The train will be operated by the Reading Co. between Philadelphia and New York, and will be the first of its type in the East, outside of New England.

An extensive expansion program has been announced by the Pacific Pump Works, Huntington Park, Calif., in the erection of a two-story administration and engineering laboratory building, as well as an addition to the manufacturing plant. A large amount of welding is employed by this concern in the production of its products.

The West Side Welders & Engineers, 218 S. Leavitt St., Chicago, Ill., has opened a school for welders, under the direction of J. M. Shephard and W. Andrews, who will give indiivdual instruction in the welding of various metals and alloys, using the metallic and carbon arcs and the oxyacetylene flame.

The Gate City Welding Co., 18th and Nicholas Sts., Omaha, Nebr., have built a portable welder, employing a new welding unit mounted on a Chevrolet chassis. The truck is 25 ft. long over all. Just now the machine is being used on plumbing work in connection with the Federal Government housing plan in Omaha.

R. P. Olson & Son, Omaha, Nebr., have just completed the making of 19 all-metal panel body trucks of all-welded one-piece construction. GMC chassis were used. Just recently this firm turned out an all-metal arc-welded body for a furniture-van company which was the largest single body ever made in Omaha.

Inquiries have been received in the Pittsburgh district from the Standard Oil Co. of Louisiana for the construction of a fleet of two or three steel tank barges with a capacity of 7,000 barrels each. Also the Standard Oil Co. of New Jersey is asking prices for three tankers with a capacity of 8,000 barrels each.

M. E. Timmons has opened a new and up-to-date welding shop on South Detroit Street, Kenton, O. The building in which the business is housed was purchased recently from Charles Jolliff and was moved to the site it now occupies. Mr. Timmons has equipped the plant for all types of welding service.

The Jones & Laughlin Steel Corp. of Pittsburgh, Pa., has launched nine out of an order of ten welded 200-ft. coal barges for use in the Monongahela River coal trade. Work has been started on 10 of the 153-ft. welded steel barges, also for use by the company. All these carriers are 26 ft. wide.

The Gulf Refining Co., of Pittsburgh, has increased to four an order of two all-welded steel tank barges placed some time ago with the Nashville Bridge Co., Nashville, Tenn. These barges will be smaller, being 130 ft. long, 28 ft. wide and 10 ft. deep. They will be used on inland-waterway service.

The Dravo Corp., Pittsburgh, Pa., recently launched the second flush-deck-type steel barge from its shipyards at Wilmington, Del. These barges are being built for the Warner Co., of Philadelphia. Material was fabricated in the Neville Island marine ways of the Dravo Corp. near Pittsburgh.

The Ryan Car Co., of Chicago, has been awarded a contract by the Union Pacific Railroad to build light-weight, all-welded underframes for 1,900 box cars and 700 automobile cars. The underframes will be built at the company's Hegewisch plant, in the south part of Chicago.

The General Oil Co., Spokane, Wash., has awarded a contract to the Columbia Steel Co., Portland, Ore., for five 130-ton all-welded steel oil barges. These barges, which will be used for the transportation of petroleum products, will be 90 ft. long, 30 ft. wide and 6.6 ft. deep.

A new 165-ft. welded steel mast has been designed for Commodore Gerard B. Lambert's big racer, *Yankee*, by Belknap & Paine. Work on the mast is under way at Lawley's yard. The cross-section of the new mast will be somewhat in the shape of a tear-drop.

The National Barge Co., with headquarters in the Magee Building, Pittsburgh, Pa., has been organized to buy and lease barges for use on inland waterway service. The company is headed by W. N. Burt, who is reported to have purchased several welded barges.

The Central Welding Co., 219 E. Fourth St., New Albany, Ind., jointly owned by H. J. Meyer and P. J. Higdon, is back to normal operation once more since the flood played havoc with the shop. Renovation of the shop is anticipated for the near future.

The St. Louis Shipbuilding & Steel Co., St. Louis, Mo., has received a contract from the Lake Tankers Corp., of New York City, for the construction of four welded oil barges of 390 gross tons each, to be 175 ft. in length, 35 ft. beam, and 8 ft. 6 in. deep.

The Omaha Standard Body Co., of Omaha, Nebr., and Council Bluffs, Iowa, is now building all-steel arc-welded bodies for trailer cabins made by the company. The skeleton of the body is all one piece, having no bolts or rivets, and is solidly welded.

The Ingalls Iron Works, Birmingham, Ala., was the successful bidder for one 50-ft. welded steel barge recently awarded by the U. S. Engineers office at Savannah, Ga. The same firm has also been awarded a 60-ft. welded steel barge by this army office.

A charter to the Welding School of Pittsburgh, Inc., Pittsburgh, Pa., has been granted by the State Department at Harrisburg, Pa. The authorized capital is $5,000 and the incorporators are M. R. Semmer, William Rodgers and J. F. Smith.

The Pittsburgh-Des Moines Steel Co., of Pittsburgh, Pa., are reported to have received a large order for all-welded tanks from the Humble Oil Co., Baytown, Texas. Approximately 2,000 tons of steel plates and shapes will be required.

Construction has been started by the California Cornice, Steel & Supply Co. of Los Angeles, Calif., on a new 88x100-ft. addition to its plant at 1600 North Spring Street. A large line of welded products is manufactured by this concern.

A modernization plan calling for the expenditure of $30,000, by the National Iron Works, welding contractors, of San Diego, Calif., has been announced. The plant is located in the concern's new quarters at 7th Avenue and Bayfront.

The Dix Machine & Welding Shop, 3421 East 9th Street, Los Angeles, Calif., has just undergone a shop enlargement in the addition of a 40x60-ft. rear building. Also, an arc-welding machine has been added.

The Ohio River Co., of Cincinnati, O., has started construction of the fourth steel barge at its plant along the Huntington wharf. It will be of all-welded construction, 195 ft. long, 35 ft. wide and 11 ft. deep.

S. M. Gram, of Dennison, O., was re-elected president of the Ohio Blacksmiths & Welders Association at the concluding session of a two-day convention held in Dayton in April.

The Duvall Welding Works, 921 E. Water St., Norfolk, Va., was destroyed last month by a disastrous fire which resulted in damage amounting to several thousand dollars.

Because of increased business, D. J. Bergman recently expanded the facilities of his welding shop in Medford, Ore., and has added a new 200-ampere arc welder.

Thieves recently forced their way into the shop of the Smith Welding Works, Monrovia, Calif., and stole about $400 worth of welding equipment and shop tools.

The Super Welding & Manufacturing Co., 2330 Orleans St., Detroit, Mich., has been purchased by Arthur R. King, who will continue the business under the same name.

Five all-welded steel coal barges of an order of 25 have already been completed by the Dravo Corp., of Pittsburgh, for the Wheeling Steel Corp., Wheeling, W. Va.

The Western Welding Works, formerly located at 749 East 15th St., Los Angeles, have been moved to 1423 Riverside Drive, on the north side of the city.

The Marietta Manufacturing Co., Point Pleasant, W. Va., recently completed an all-welded steel towboat hull for use in inland-waterway service.

William E. Young has formed a job welding shop under the name of the All Metals Welding Co., at 4663 St. Jean Ave., Detroit, Mich.

The Economy Welding Co., 18th and Cuming Sts., Omaha, Nebr., has added 20x66 feet more space to the shop, making 66x66 feet over all.

The Bellevue Welding Service, Bellevue, Pa., has moved to its new location at 613 Lincoln Ave. D. A. Carmack is the proprietor.

The Hebeler Welding Co., Buffalo, N. Y., has moved to larger quarters, the new address being 1005 Jefferson Ave.

Quiggle & Withnell, 2020 Cuming St., Omaha, Nebr., have added arc welding to their general garage work.

The Fremont Foundry Co., Fremont, Nebr., has added an arc-welding machine for general foundry work

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With this reconstructed section this punch drove 700 $1^{7}/_{16}$ holes through $^{1}/_{4}$ in. 15% carbon steel and showed absolutely no sign of wear!

Agile Dark Green Arc Rods are just the thing for repairs to machining tools, cutting edges, plow shares, punches, etc. Also for cold-welding pig-iron castings. They make a clean, dense weld, produce no slag, and become glass-hard when quenched. Hardness 570-600 Brinnel.

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DEALERS: Some territories are still open.

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Gentlemen: Without obligation send me samples of Agile Dark Green Electrodes. I have checked diameter wanted.
☐ $^{1}/_{16}$" ☐ $^{5}/_{32}$" ☐ $^{1}/_{8}$" ☐ $^{5}/_{32}$" ☐ $^{3}/_{16}$" ☐ $^{1}/_{4}$"

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Company _____
Address _____

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Bargains—Demonstrator Arc Welders. Today's biggest profit maker in service shops. Easy terms. Thirty days' trial to prove its money-making ability. Write for free booklet on Arc Welding Profits. Ken's Welder Exchange, Box U-572, Troy, O.

Fly Ball Governors—Adapted to all makes of auto engines; belt driven, flat or V. Price, $6.50 prepaid. Ball bearing, $2.00 additional. Satisfaction guaranteed. In ordering state style of belt. Wm. Alber, Beatrice, Nebr.

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Combination Welder Wanted—Must be thoroughly competent job-shop man, understanding preheat work and boiler making. State age, married or single, give experience and where employed for the past several years. Union shop, steady long-time job to right party. Broadway Welding & Machine Works, West 1021 Broadway Ave., Spokane, Wash.

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Let Us Rebuild Your Torches, regulators and gauges. Complete repairs to all makes of welding equipment and pneumatic tools. Welding Equipment Service Co., 2108 Cabrillo Ave., Torrance, Calif. Telephone Torrance 529.

POSITIONS WANTED

Welder Foreman or Welder—Desires connection with company in South. 10 years' experience. Prefer contract 12 months' salary basis. Address May-3, The Welding Engineer.

Arc Welder—3 months' school training, 8 months' practical experience. Will work anywhere within 30 miles of Blue Island, Ill. Joseph Zwijack, 2746 W. Broadway, Blue Island, Ill.

Blacksmith and Welder—Can do any kind of blacksmithing. About 10 years' experience in oil-country shop. Also gas and arc welding. Age, 37. Roy W. Henry, Penn. Ave., Knox, Pa.

Welder—29 years old. Welding 7 years, gas and arc. Job shop, maintenance, production and foreman experience. A-1 references. Would like to contact with company who would provide advancement. Ray S. Burkholder, 605 S. Vine St., Orrville, O.

Combination Welder—7 years' experience. Has complete oxyacetylene welding and cutting equipment and portable gasoline-driven arc-welding generator. Want permanent position with a dependable company, with or without equipment. John F. Williams, Dines, Wyo.

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Greater Profits This Spring Than Ever Before

Use NEW PROCESS high carbon abrasion resisting steel reclaiming units for plow shares, planter runners, cultivator shovels, sweeps, and other farm implements.
LARGEST MANUFACTURER OF A COMPLETE LINE OF RECLAIMING UNITS FOR ALL FARM TILLAGE TOOLS.

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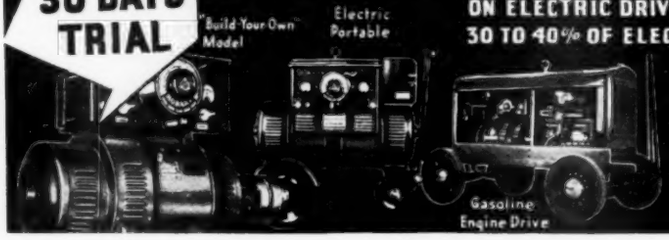

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